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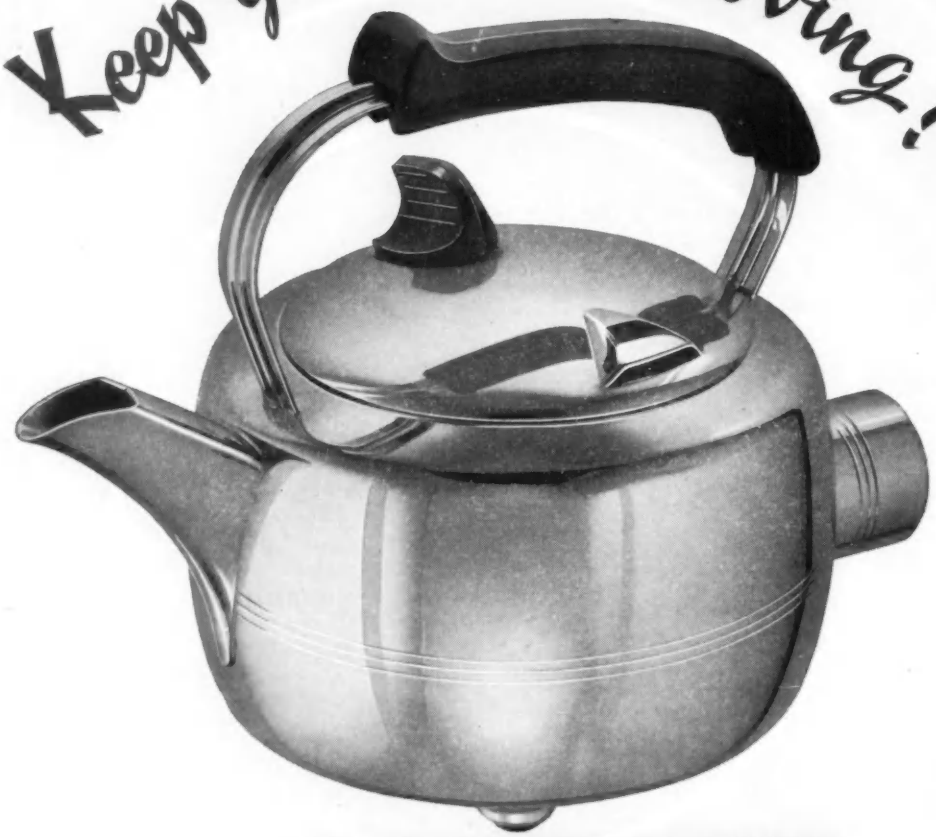

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ELECTRICAL REVIEW

10 April 1959 Vol. 164 No. 15 Established 1872

Teaching Fundamental Theory

THERE is an increasing awareness that the methods of teaching basic theory which are employed in our universities and technical colleges are inadequate to meet present-day needs. The probable reason is that, until comparatively recently, the fundamental theory of magnetism and electricity was considered to be almost exclusively the preserve of the physicist. But there seems to be no reason why an adequate and logical, albeit simplified, explanation of the basic principles of electrical engineering was not taught years ago. Even now, most undergraduate courses start by considering the forces between unit poles or unit charges—a practically useless concept. However, the greatest defect in the accepted method of teaching is that no attempt is made to relate magnetism and electricity. Obviously, the student is confused and handicapped from the start.

A most important part of any course is the introduction, and, if the fundamentals are not given the appropriate emphasis and put into the correct perspective at the outset, the average student will never have a clear understanding of the subject. It should not be left to the brilliant student to unravel for himself the basic facts from the accepted teaching method.

Because of the rapid developments in science during the last twenty years the situation has grown steadily worse and it has now become vital for all electrical engineers to have a thorough grounding in the basic theory. This is the object of the method described by Mr. A. T. Craven in this issue. The approach which he suggests is simple and logical. For instance, a physical understanding of field phenomena is obtained by considering familiar subjects such as the flow of fluids. The second main object of the author's method is to make the student deduce for himself the fundamental theory. In this way, the subject is made interesting and logical.

As well as the radical revision of the teaching of the fundamentals, a brief description of main modern theories of science and their historical development would not be out of place in a general electrical engineering course. Perhaps the first major achievement, and the one to which there is extensive reference in Mr. Craven's article, was Maxwell's mathematical theory showing that electricity, magnetism and light were closely related, and that light waves were electromagnetic waves of certain frequencies. Einstein reformulated the physical laws of nature in conformity with the fact that light travels at the same speed regardless of the relative speed of move-

ment of the observer. Einstein also discovered the relationship between matter and energy, the basis of nuclear engineering, and put it into his famous formula, $E = mc^2$.

Some phenomena of light cannot be explained by the wave theory. Modern physics states that energy is granular, light being composed of particles called photons. The behaviour of individual photons cannot explain all the observed facts of light, but these are, however, found to be consistent when considered from an entirely different standpoint—that of the quantum theory. This theory is really a form of statistics and determines laws of averages governing large quantities of particles.

There is thus a pressing need for a new approach to make the teaching of the fundamentals of electrical engineering interesting and logical, and we feel that Mr. Craven's article is a step in this direction.

JOINT CONSULTATION

Much attention is given in the electricity supply industry to the subject of joint consultation between the Boards and their employees—a subject specifically provided for in the Electricity Act of 1947. There seems to be a certain amount of detachment on the part of the representatives of the employees on the Local Advisory Committees which form the ultimate contact between the two parties. The difficulty of interesting the mass of employees in the work of the L.A.C.'s is recognised in an article by Mr. A. N. Irens, chairman of the South Western Electricity Board, in the latest issue of *Joint Consultation*, a magazine issued by the National Joint Advisory Council of the industry. Mr. Irens shows that there should be a two-way traffic in ideas—from the L.A.C. to the body of employees and vice versa. He says that there is a wealth of untapped opinion and experience among the people in the industry and the L.A.C.'s should find means of channelling this opinion and experience to their meetings. The same question is discussed in other articles in the magazine. One contributor says that one purpose of L.A.C. reports is to enable the Committees to publicise their work. To attract the attention of employees the reports should be in easily readable form.

DIRECTIONS OF EXPANSION

Expansion is now the watchword for the nation's economy and very welcome it is after the period of restriction through which we have passed. One important aim of restriction was to reduce consumption at home in order to encourage production for export. But the wisdom of going too far in this direction is questionable. It is axiomatic that export trade must be based on a sound home market, both to spread costs and to provide a cushion against the fluctuations in overseas demand.

There is, however, a danger that over-stimulation of purchasing in the home market may militate against export trade. Manufacturers find it much easier to sell their products in this country than abroad and for this reason it needs strong determination to devote a reasonable amount of effort to the cultivation of overseas markets. Enlightened manufacturers know that this country lives by its exports and they have achieved much in difficult conditions. More firms should now realise that expansion requires not only selling more at home but also increasing overseas trade.

NUCLEAR PLANT FOR JAPAN

Over two years ago a Japanese delegation visited this country to inspect the Calder Hall nuclear power station in order to determine whether a station of this type would be suited to Japanese conditions. Since that time there have been continuous negotiations between Japanese representatives, the United Kingdom Atomic Energy Authority and the British nuclear power consortia. Discussions resulted finally in the Japanese selecting the G.E.C. - Simon-Carves group as the probable suppliers of the plant and last week the Japan Atomic Power Co. issued a "letter of intent" to the G.E.C. for the construction of a 150 MW station in Japan. This is most satisfactory from the country's point of view, as well as from that of the G.E.C., to whom the order will be worth about £20 million.

EARTHQUAKES AND NUCLEAR PLANT

One of the main problems associated with the design of the nuclear generating plant which the G.E.C.-Simon-Carves Group is to supply to Japan has arisen from the fact that earthquakes may possibly occur in the area where the power plant is to be constructed. Obviously, the reactor must "fail safe" and the design is such that it will do so under earthquake conditions far worse than anything which has so far been recorded in Japan. Although the Japanese station is of the Calder Hall type there are differences in the arrangement of the plant. For instance, the reactor and the four heat exchangers are all contained within a single building and are mounted on a common massive concrete raft so that they will all move together should there be an earthquake.

The safety devices have been so designed that even if the whole plant were tilted to an angle of 45 degrees the reactor would still shut down automatically. To take account of the possible distortion of the graphite moderator under these conditions the control rods are all separately operated, unlike those at Calder Hall. Another method of shutting down the reactor which might possibly be used as a last resort is to fire boron steel balls into the moderator, the idea being that these would be sure to pass down through fissures in the damaged graphite.

UNJUSTIFIABLE SECRECY

Much publicity has been given to a "secret trial" conducted by officials of the Electrical Trades Union last week-end. The "defendants" were two ex-Communists and another member who were alleged to have divulged union affairs to outside parties. At the time of writing the "verdict" is not available.

A century or so ago when trade unions were illegal organisations their operations were necessarily conducted in secret—even under oath. To-day, when trade unions are recognised as an essential part of the industrial structure it seems absurd that they should be afraid of the daylight.

Aluminium Foil and Strip for Electrical Windings

By J. J. LEE, Graduate I.E.E.*

PRODUCTION, CHARACTERISTICS AND APPLICATIONS

The designer must think in terms of aluminium rather than copper equivalents, and should take into consideration the physical properties of the material he is dealing with. The article indicates the characteristics of the material, including the electrical properties of the anodic film, and has been prepared primarily to guide designers now considering strip winding; but each design case must be considered on its own merits

NOW that satisfactory processes have been developed for producing artificial oxide films on aluminium (Al_2O_3) by electrolytic process, i.e. anodising, it is possible to view the use of aluminium for electrical windings in a new light. In the past, adverse criticism has been directed against aluminium in electrical windings because of the relative current carrying capacity of aluminium when compared with copper. It is well known that the proportional conductivity of electrical purity aluminium is 61 per cent I.A.C.S. (International Annealed Copper Standard), which means that for equal I^2R losses in the aluminium, the cross section of the aluminium conductor will have to be 1·64 times as large, resulting, generally speaking, in a more bulky winding. What is not so well known, however, is that the current carrying capacity for aluminium to give the same temperature rise is 78 per cent of that of copper. This means that the cross sectional area of aluminium conductor need only be increased 1·282 times that of copper. The former statement is based on the assumption that existing insulating materials will be used, and the latter that such factors as emissivity and heat transfer are not taken into account. If consideration be given to the use of anodic films, which may be only several microns in thickness, the dimensions of the aluminium winding need be no greater than the corresponding copper winding for equivalent I^2R losses, and if current carrying capacity may be utilised the winding may be even smaller; consequently the total space occupied would remain unaltered or be decreased. Furthermore, this extremely thin insulation and the use of strip in a coil in place of wire, results in very good thermal conductance inside the core; hot spots are eliminated almost entirely and heat dissipation is excellent.

At present, the economies that may be achieved by using aluminium are not always readily apparent, and in the smaller sizes of anodised aluminium foil or strip the position may be unfavourable. In the larger sizes, however, e.g. where the cross sectional area of the conductor is of the order of 0·015 sq in or over, cost savings become apparent, and the material becomes more attractive as the area increases. It should be noted, however, that the quantity of material also enters into the economic consideration. Large bulk supplies will be cheaper in terms of cost per lb than a small quantity.

At this point it may be advantageous to differentiate between material in the strip and foil forms. Foil is generally defined as material not exceeding 0·006in thick; strip is material greater in thickness than this, but not exceeding 0·25in.

During the last few years a number of anodising processes have been investigated with the object of determining the most satisfactory and economical one to adopt. In many cases it has been found that two or more processes are necessary to produce a film which is impervious to humidity changes. Some of these two-stage processes comprise two separate anodising procedures which are costly and have proved to be uneconomical. This does not apply to the common sulphuric acid process, which yields a film of hydrated aluminium oxide consisting of two layers—a very thin completely continuous layer (the barrier layer) next to the metal, and an outer layer which is many times thicker and is composed of many hexagonal cells resembling a honeycomb, Fig. 1. This outer layer is capable of absorbing impregnating materials, thus offering interesting possibilities not yet explored. The anodic film, although susceptible to some extent to humidity changes, is

* Electrical engineer, Aluminium Development Association.

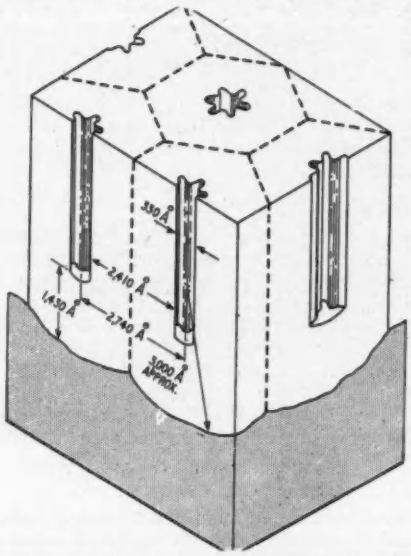

Fig. 1.—Structure of the artificial oxide film on aluminium produced by anodising. It comprises a continuous film adjacent to the metal (the barrier layer) and a much thicker superimposed porous layer of honeycomb structure. This layer can absorb dyes or suitable impregnants. Magnification ×65,000: dimensions in Angstrom units

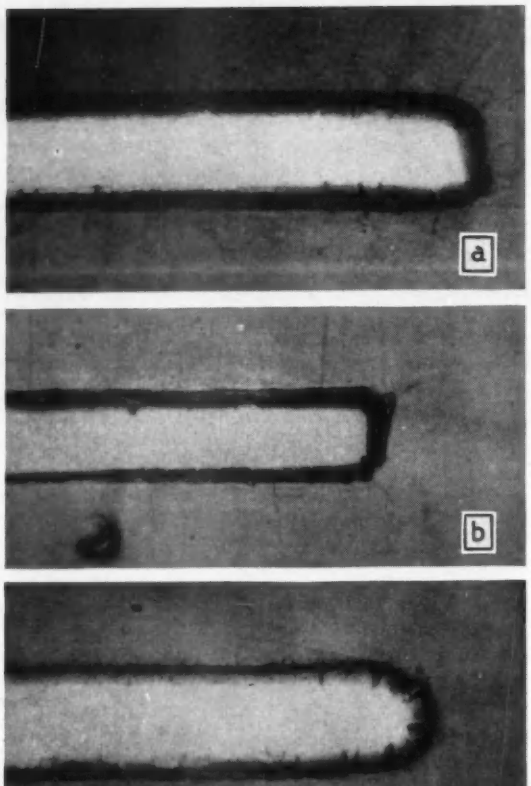

Fig. 2 (a, b and c).—The anodic film on aluminium foil 0·075 mm thick. Magnification ×200. The film is approximately 25 microns thick and average breakdown voltage for the three samples is 403, 303 and 422 V r.m.s., respectively; note continuity of the film round the relatively sharp edges in (a) and (b)

suitable for electrical windings. At the present time anodised strip, which is commercially available from producers now operating in this country, is anodised by the sulphuric acid process.

Electrical Characteristics

From tests conducted on samples of material anodised in this manner, minimum voltage breakdown figures of 200 V r.m.s. have been obtained on anodic film thicknesses of the order of 0·0002in (5 μ). It is possible to design coils, therefore, with interturn voltages not exceeding this value. The three most important characteristics of an anodic film are the electric strength, the permittivity and the resistivity. These values will vary with methods of producing the oxide film and the thickness of the film. Conservative and reproducible figures in the case of the sulphuric acid process are:

Electric strength = 47·2 kV/mm
Relative permittivity = 7·5–8.

It must be borne in mind that the electric strength has been calculated from values obtained from a very thin film and does not indicate that such a figure would be obtained from the more usual thicknesses. It is sometimes necessary to know, also, the loss tangent and resistivity of the film. At the present time, however, these have not been established.

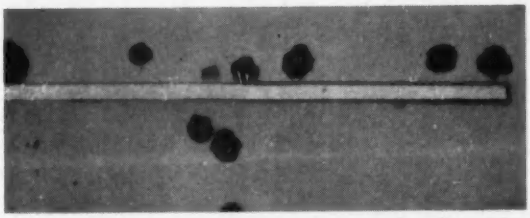

Fig. 3.—Cross-section of film on 0·075 mm foil thickened towards the outer edge by special treatment. Magnification ×30. The film is 0·001in (25 μ) thick at the edges, diminishing to 0·0003in (7 μ) at the centre

Naturally, it is important that the film should be continuous, particularly at the edges of the strip or foil. Continuity is influenced both by edge contour and anodising technique. Generally speaking rounded edges are preferred, with absence of burrs and sharp points. A satisfactory edge condition can now be achieved, however, in good continuity of the anodic film even when the edge is not smoothly rounded: Fig. 2 (a, b and c) shows a continuous film on edges of varying contour. If necessary the anodic film thickness can be increased towards the edges in order to give higher electric strength at these vulnerable places: Fig. 3 shows a cross section through material so treated which gave an average voltage breakdown of 342 V r.m.s. at the centre and 403 V r.m.s. at the edges.

Mention has been made of the equivalent I^2R losses when considering cross sections of aluminium conductors; this is of importance in power engineering, as it is inadmissible to increase the load losses. If the minimising of load losses is not of importance, however, then it is possible to increase the current density in the aluminium winding, with a resulting increase in temperature. The heat generated by the increased current density is partly absorbed by the thermal capacity, as the specific heat of aluminium is far greater than that of copper; a further proportion is lost by dissipation because of the improved heat transfer characteristics of the winding, and the remainder causes a temperature rise in the winding. Conversely, in view of the increased thermal capacity of aluminium, it is possible to allow for a higher current density for the same temperature rise. The specific heats of aluminium and copper are:—

Aluminium = 0·230 cal/gm/deg C
Copper = 0·095 cal/gm/deg C

For determining resistance of aluminium strip at higher or lower temperatures than 20 deg C, a figure of 0·00403 deg C may be used as the constant mass temperature coefficient. If large variations of temperature are envisaged, however,[2] the following formula may be applied[3]

$$\frac{P_\theta}{P_0} = 1 + 0{\cdot}3867 \times 10^{-2}\theta + 1{\cdot}10 \times 10^{-6}\theta^2$$

where P_0 = resistivity at 0 deg C
and P_θ = resistivity at θ deg C

A value often quoted for current densities in copper is 1,000 A/sq in. In the case of aluminium this figure does not apply and the current density of the conductor should be calculated on the basis of permissible temperature rise.

Resin Coated Materials

It is possible to wind coils from resin coated material which has the same space-saving advantage as anodised material. The resin, of the epoxy phenolic type, may be cured *in situ* on the finished coil, making it extremely strong mechanically. There are temperature limitations,

however, which restrict the use of such coils to about 180 deg C. One point worth considering is that, for very small gauges of material, there may be an advantage in using this type of winding material. Reference should be made at this point to the use of aluminium strip wound with interlayer insulation. This type of coil, although requiring increased volume for equivalent load losses, may yet offer economic advantages over the corresponding copper strip and wire wound coils. But this winding is not capable of high temperature performance, as the insulating materials may be used only at much lower working temperatures than Al_2O_3 films; further, its heat dissipation from the interior of the coil is not so good.

Flexibility and High Temperature

The flexibility of anodic films is dependent on the anodising process and also on the thickness of the film. By suitable adjustments very flexible films can be obtained. It has been shown by experiment that the special anodising process, generally known as " hard anodising," is unsatisfactory in this respect, and it has not therefore been adopted.

The use of normal sulphuric acid processed material has shown this to possess good flexing properties. Anodised foil 0·0035in thick may be wound round a mandrel of 0·125in diameter without damage to the film, the film thickness in this instance being 0·0002in (5 μ). This is usually quite adequate for coil winding. Flexing tests on material on which thicker anodic films have been deposited show a slight diminution in flexibility.

Abrasion resistance of anodic films is also good, both on the flat surface and on the edges: rubbing the edges of material together quite vigorously did not damage the film in a test, the potential between individual samples remaining at 250 V.

Coils wound of anodised aluminium foil or strip may be operated at temperatures in the region of 500 deg C without deterioration of the oxide film, which is advantageous where ambient temperatures are high, such as in atomic energy reactors, supersonic aircraft, or guided missiles.

The operation of aluminium windings at elevated temperatures is dependent in the main on the insulating material being utilised and on the adjacent components. In the case of an oxide film the limitation of temperature working is determined by the melting point of the conductor itself (659 deg C for aluminium), the melting point of the oxide film being considerably higher than this (2,050 deg C). This condition is unique. In no other case is the conductor melting point lower than that of the insulation. Apart from the thermal capacity and insulation considerations for aluminium windings, there is also the advantage of heat transfer characteristics which are exceedingly good. In the case of stripwound coils, the temperature gradient across the winding is small and uniform, obviating high spot temperatures and possible resulting failures which may occur in conventional windings. These unique characteristics have been substantiated by the continuous operation of anodised aluminium coils at temperatures up to 500 deg C.

Reduced Safety Factor

In transformers and motors where possible fault condition current loadings have to be taken into account in design, it is of interest to note that when copper and conventional insulating materials, or even silicone varnishes, are used, a large safety factor is allowed on the rating of the conductor for temperature rise reasons. In the case of anodised aluminium, these large safety factors may be greatly reduced in view of the improved heating and cooling characteristics: the coils are capable of withstanding considerable surges.

Coil Winding

There is a definite saving of time in winding coils of strip in preference to round wire winding, and the technique lends itself more readily to automatic control. Modifications to coil winding machines will be necessary to ensure good line-up of the layers. It is possible that some electronic device coupled with a photoelectric cell may provide a means of obtaining extreme precision windings.

Anodised material in foil and strip forms is commercially available from a number of manufacturers in this country; two such are Tyne Chemical Co., Ltd., River Drive, South Shields, and Acorn Ano-Coil, Ltd., Boreham Wood, Hertfordshire. Anodised wire and certain sizes in drawn strip are available from the Aluminium Wire & Cable Co., Ltd., 30, Charles II Street, St. James's Square, London, S.W.1.

The sizes range from foil as narrow as 0·125in wide to strip material 20in wide. In the intermediate sizes,

Fig. 4.—Experimental anodised foil winding of 100 turns made from material 1¼in wide by 0·006in thick

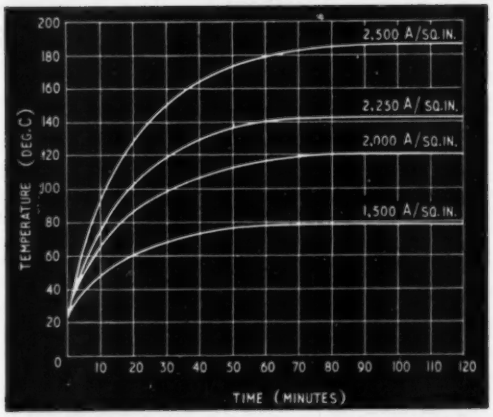

Fig. 5.—Temperature-current data for the experimental coil shown in Fig. 4

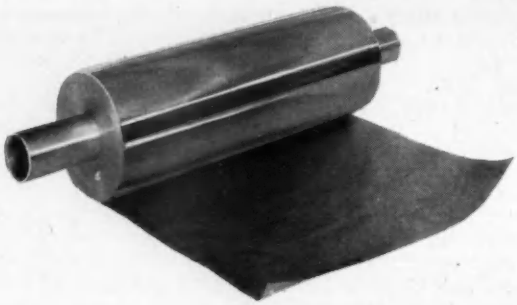

Fig. 6.—Coil wound from aluminium foil coated with resin varnish and used for a small electromagnet (see Fig. 7)

Fig. 7.—Travelling wave tube incorporating an electromagnet energised by resin coated aluminium foil. (Courtesy of English Electric Valve Co., Ltd.)

thicknesses range from 0·001in to 0·064in depending on width. Typical sizes are foil 0·375in wide by 0·003in thick, 4in wide by 0·003in thick, or strip 6in wide by 0·010in thick. Material used by manufacturers may be of electrical purity supplied to the maximum resistivity value (2·8264 microhms/cm²/cm); or it may be of 99·0 per cent minimum purity for foil and 99·5 per cent minimum purity for strip. Unanodised material is also available without restrictions on width or thickness for use in interleaved windings.

Material is usually supplied in an intermediate or hard temper, which is the most suitable for winding: some material is supplied in the soft or fully annealed state, but this tends to stretch and lose shape when handled and coiled.

Present Applications

At the present time the manufacture of anodised and interleaved aluminium windings is beginning both on a production and an experimental basis. An anodised coil (Fig. 4) is manufactured from anodised foil material 0·006in thick and 1·5in wide, of a hundred turns. From experiments conducted on this coil it has been possible to obtain quite high current densities with temperature rises ranging from 78 deg C to 186 deg C as shown in Fig. 5. There is a notable absence of hot spots. From this graph it can be seen that despite the higher specific resistance of aluminium conductors, a small cross sectional area with resultant high current densities and operating temperatures are well within the scope of the anodic film.

In the electronic field headway has been made in using aluminium foil windings for travelling wave tubes.[1] In this application the coil, Fig. 6, was wound, using resin varnish as the insulation between turns. The volume is approximately the same as that of a copper wire coil but the weight has been reduced to a third. The minimum field required to focus any particular travelling wave tube is up to 25 per cent less with the foil coil. The completed electromagnet for a power output travelling wave tube is shown in Fig. 7.

Automobile use of aluminium strip has taken a step forward by the introduction of field winding for engine starters. Fig. 8 shows a production set of these windings.

The space factor has so far been considered on the basis that aluminium strip would replace copper strip. If in actual fact the aluminium is replacing conventional round section copper wire, then it is quite probable that the space factor for coil cross-sectional area would be considerably improved.

The main attraction of aluminium strip windings is the added scope offered to the designer by the anodised material for high temperature operation. Air-cooled transformers, working in the Class H condition, are but one example. Making allowances for increased conductor area, the overall volume of the winding will remain the same, or in some cases will be even smaller. If a reduction in area is obtained, a corresponding reduction in core material may be achieved. This applies equally well in the case of power transformers as the load losses would remain unaltered. Advantageous changes in capacitative reactance of the windings may be achieved.

There are certain advantages to be gained from the use of anodised aluminium for rotary machines, where they are working at high temperatures, particularly in the case of d.c. machines where both field and rotor windings of aluminium may reduce space, heating and inertia problems. Use of aluminium windings, either of the interleaved or anodised type, may be of advantage where weight is concerned, for example, in lifting magnets. Weight may be considerably reduced, sometimes by as much as 50 per cent, by replacing copper with aluminium. The actual saving will depend on the space occupied by the copper winding being replaced. Generally speaking the space factor of an aluminium winding is likely to be between 0·99 and 1·0.

The operation of electrical machines in road vehicles may be improved by being wound with anodised aluminium, in particular engine starters and dynamos. In the case of starter motors the conductor area may be considerably reduced as the heating loss is much smaller than with copper. There may also be a case in the transport field

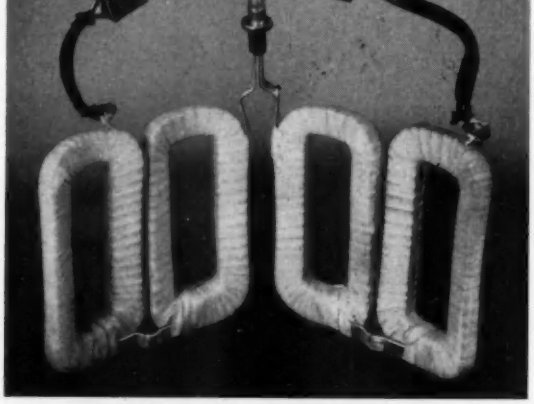

Fig. 8.—Field coil winding for an automobile starter, comprising four coils of electric purity aluminium drawn strip 0·25in wide, 0·045in in thickness with rounded edges. Paper interleaving is used for insulation; aluminium/aluminium and aluminium/copper joints are involved, made principally by resistance welding methods. (Courtesy of Joseph Lucas, Ltd.)

for introducing aluminium windings into such items as ignition, headlamps and horn coils.

One of the deterrents to using aluminium windings in the past has been the jointing problem: scepticism has existed on the jointing of these coils, which is fostered largely by lack of familiarity with aluminium for electrical conductors, but it is actually quite unwarranted when the facts are considered. One important general point is that strip and foil windings present a large contact area available for jointing and this, in the main, renders the problem easier to solve than with wire windings. It is now possible to produce satisfactory joints by spot welding, cold welding, ultrasonic welding, soldering and mechanical jointing.[4] The welding methods are straightforward, but in the case of soldering there is a choice of methods which may be adopted.[5] In the case of unanodised aluminium it is possible to use a flux and a special solder to make good joints, or the use of an ultrasonic soldering iron and solder without flux. In the case of anodised aluminium an ultrasonic activated solder bath may be used, in which the anodic film is broken down as it is dipped into the bath, enabling the aluminium to be soldered. If a more robust method of jointing is required it is quite permissible to make bolted joints, with the proviso that the mating contact surfaces are abraded with a wire or nylon brush to ensure breakdown of the oxide film. The mating surfaces of the aluminium may alternatively be treated with a jointing compound which dissolves the oxide film. Cold welding is readily accomplished on anodised aluminium, and the need for scrupulous cleaning of the surface and scratch-brushing is eliminated.

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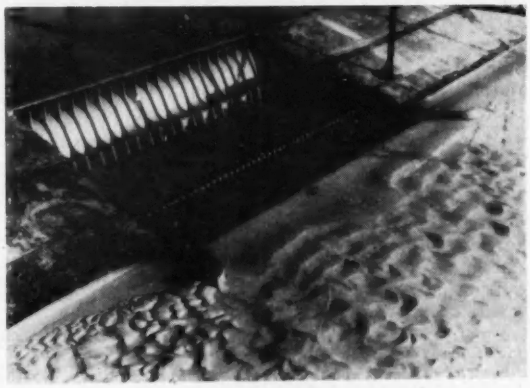
Italian Hydraulic Laboratory

ALTHOUGH a great deal is known about the mechanics of the flow of fluids, it is still necessary to determine many features of particular hydro-electric projects empirically. In order that models of hydro-electric plants can be studied the Società Edison has built a hydraulic laboratory at Niguarda, Italy. The equipment consists of a horizontal concrete stage measuring 20 by 52 metres and surrounded by retaining walls ranging in height from 50 to 120 centimetres, a pumping unit (two feed tanks, each holding 70 cubic metres of water, and two pumps with a capacity of 100 litres per second and head of eight metres), a constant-level reservoir with shutters regulating the admission of water, a shutter which regulates levels, and a 70-metre long canal which is used for the return of the water. The whole plant is situated in the open air, but during severe weather a roofing on tubular scaffolding can be installed over the models being tested.

At this laboratory, considerable stretches of the river to be harnessed are reproduced to scale, so that the hydro-dynamic features of the bed of the river and of the modifications to be introduced into it can be studied. The scales that have been used so far are: 1:75, 1:60 and 1:150. Generally, the bed of the river is modelled in concrete, if the area to be studied is rocky, and of very fine siliceous sand if the river flows through alluvial layers subject to erosion.

The model of the dam to be studied is built of wood, suitably processed to prevent its swelling under the action of water. Wood has been chosen because of the ease of making modifications. The water flow is observed and any necessary modifications are made to the dam and the possible undesirable interaction of various parts of the flow is studied. Attention is paid also to the effects of erosion upon the model river bed. To make this work more efficient, numerous photographs are taken.

Models of the following plants have been studied so far at this laboratory:—Bariri and Ibitinga on the Rio Tiete in Brazil (scale 1:75) and the Rio Hondo dam in Argentina (scale 1:60). At present, the technicians of the laboratory are preparing a test model of the large plant planned at Urubupunga (Brazil), the scale adopted being 1:150.



Tests of the model of Rio Hondo dam

General view of the hydraulic laboratory at Niguarda

Teaching of Electrical Engineering

A NEW APPROACH TO THE FUNDAMENTALS

By A. T. CRAVEN, B.E.E., A.M.I.E.(Aust.)*

MODERN developments in electrical engineering have rendered the usual methods of teaching electricity and magnetism hopelessly inadequate. The experimental laws of Coulomb, Ohm, Ampère and Faraday, long considered to be the fundamentals of electrical engineering, can no longer be so regarded. A new approach has, therefore, been developed by the author over a period of years. For a discussion of the reasons why it was considered necessary to restyle the teaching of the basic principles of electrical engineering, readers are referred to an earlier paper.†

This new approach to the teaching of electricity and magnetism has two prime objectives, namely:—

(*a*) To establish in the mind of the student, at an elementary level, a physical understanding of the general concepts which are common to all field phenomena. This is achieved by a thorough study of field phenomena, such as flow of fluids, which are familiar to the student in everyday life and are concrete and easily imagined.

(*b*) To deduce the fundamental theory of electricity and magnetism from three fundamental observations, two of which embody the physical meaning of Maxwell's equations, and thus to lay a solid foundation for an understanding of all of modern electrical engineering practice.

Introduction

The new approach starts with the usual explanation of the electrical nature of matter. Atoms, electrons and protons are described. The fact that matter is one form of energy is emphasised, and the various forms in which energy can exist are described. The idea of energy conversion and transmission is so basic to electrical engineering that it cannot be introduced too soon or emphasised too strongly.

The idea of electric charge is explained and is defined pictorially in terms of numbers of electrons or protons. Although the actual physical nature of the fundamental particles and thus of matter is admitted to be a complete mystery, the aim throughout the subject is to show how electric charges behave and how they can be made to behave in a way which will benefit mankind, without worrying about what they are. This attitude of mind is important when the student comes to consider electric and magnetic fields.

The various ways in which bodies may be charged, by friction, chemical action, contact, etc., and the electric properties of materials resulting from their atomic structure —conductors, dielectrics, electron emission, etc.—are explained. The ensuing study of electricity and magnetism is based on three fundamental observations of physical facts, upon which the whole structure of the subject is built.

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† "The Teaching of Electricity and Magnetism to Electrical Engineers," Manchester College of Science and Technology, *Bulletin of Electrical Engineering Education*, June, 1958.

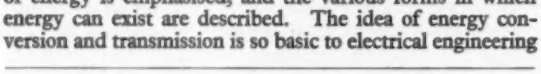


Fig. 1.—Fields of fluid flow

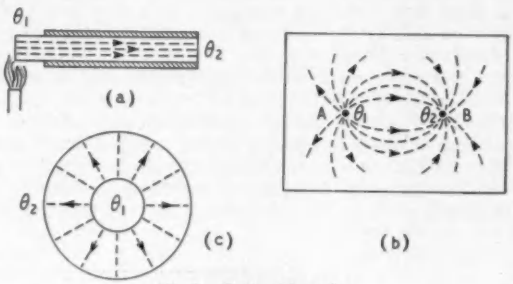


Fig. 2.—Fields of heat flow

First Fundamental

It is observed that " the region surrounding any charged body is affected by the charge in such a way that any other body situated in that region is acted on by a force."

This region is called an electric field and can be observed by sprinkling fine powder around charged bodies of various shapes. At this point, the first important feature of the new method is introduced. It is no use attempting to take the average student any further with the theory of electric fields without making him familiar with the meanings of the general concepts relating to fields. Thus, considerable time is now spent on field problems with which the student is already familiar from everyday experience, or which, at least, are easily imagined.

Familiar Concepts

To bring out the important ideas applicable to all field problems, several simple examples of the following familiar fields are considered:—(i) Fields of fluid flow. (ii) Fields of heat flow in heat conducting material. (iii) Fields of strain in elastic material. These phenomena are familiar in everyday life. The fields of flux are concrete, and clear mental pictures can be formed, in contrast with electric and magnetic fields.

(i) *The field of fluid flow.* Four simple fields of fluid

The traditional methods of teaching electricity and magnetism have become inadequate. The author has developed a new method with the objectives of establishing a physical understanding of the fundamentals by considering familiar phenomena and the deduction of the theory from three fundamental observations. Mr. Craven invites constructive criticism of the method outlined

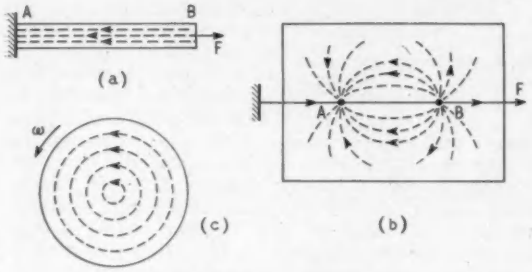


Fig. 3.—Fields of elastic strain

flow are illustrated in Fig. 1. Fig. 1 (a) shows water flowing along a straight pipe AB, the pressure head depending on the height of the water in tank A above that in tank B. Fig. 1 (b) shows the flow of air around an open wind tunnel and Fig. 1 (c) around an enclosed wind tunnel. Fig. 1 (d) shows water circulating freely in a tub.

(ii) *The field of heat flow.* In Fig. 2 three cases of heat flow in heat conducting material are illustrated. Heat flowing along a straight insulated bar is shown in Fig. 2 (a) and Fig. 2 (b) shows heat flowing from a hot spot A to a cold spot B in a heat conducting sheet. Fig. 2 (c) shows radial flow of heat through the walls of a hot water pipe.

(iii) *The field of elastic strain.* Fig. 3 illustrates three cases of fields of elastic strain. In Fig. 3 (a) a bar is rigidly fixed at end A and a force F is applied to end B. In Fig. 3 (b) a sheet of elastic material is rigidly fixed at point A and a force F is applied at point B. A rotating elastic disc, stressed by centrifugal force, is shown in Fig. 3 (c).

Definitions

All the important concepts required in electric and magnetic fields may be explained by reference to these examples. Some of the more important ones are as follows:—

(*a*) *Field.* The field is simply the region at any point of which the physical entity under consideration may be detected. It is important that the student should realise that a field may be limited to a definite confined region as in the cases of Figs. 1(a), 2(a), 3(a), 1(c), 1(d), 2(c), 3(c) and is not necessarily an unlimited region as the standard course in electricity and magnetism implies. This idea is important for fields of current flow in conductors.

It is also useful to point out that terms used in field theory such as field, potential, etc., have meanings similar to their meanings in everyday language. Thus, a field of grass is simply a region at any point of which we may detect grass.

(*b*) *Flux.* The term flux simply means flow, but this needs to be extended to cover all cases. With fluid or heat flow the meaning is quite simple, the flux simply being the amount of water entering or leaving the pipe per second or the amount of heat flowing past any point in one second; i.e. simply rate of flow.

For elastic force, however, the flux is the " force transferred " from B to A through the material. There is no actual flow, but, when a force is applied at B, an equal and opposite force appears at A. As shown later, this case is exactly analogous to electric flux and is extremely useful in giving the student a concrete picture of the electric field.

(*c*) *Streamlines, flux path and flux density.* These ideas are easily explained by reference to flow of water. The student can easily appreciate the use of streamlines to indicate the path followed by the water, the flux path, and the concept of flux density in pipes of varying cross-section. The density of the streamlines obviously indicates flux density. Also, when the streamlines are straight and parallel, the field is uniform. The uniform field is the simplest to deal with and each new type of field should be introduced by considering a case where the field is uniform. In the normal method of dealing with electric and magnetic fields, young students are introduced to non-uniform fields which are much more difficult to comprehend.

(*d*) *Potential.* One of the most serious faults in the normal teaching methods is the way of introducing the concept of potential. Potential is tied for ever, in the mind of the student, to work done per unit charge. No attempt is made to give the student an appreciation of the physical nature of potential itself.

It is just as if a teacher in introducing young students to velocity, defined velocity simply as length divided by time, deliberately concealing from the student the fact that velocity has any physical significance in terms of actual movement of objects.

In fact, the concept of potential exists in its own right and need not be connected with work done at all. To explain the concept of potential, we can refer again to the meaning of the word in everyday usage. The word potential simply means latent ability to do something. Thus a boy is said to have potential in some field of activity. To exploit that potential the necessary conditions must be available.

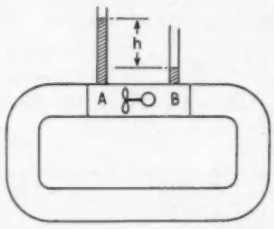


Fig. 4.—Fluid analogy illustrating the meaning of potential

The technical meaning of the term can be illustrated by considering Fig. 4. Imagine that initially the path is blocked as shown at A and B, so that when the propeller is driven, the fluid at A is compressed and at B is decompressed creating a difference in potential measured by the pressure head " h." The fluid at A has high potential because it is potentially capable of causing fluid to flow around the circuit if the blockage is removed. When the path is opened, the field of flux is propagated in a short period of time and each point around the path acquires a definite potential (pressure) which falls along the direction of the flux. The fact that there is always a transient period while the field is being established is important.

When heat flows in a conducting material, thermal potential is measured in terms of an arbitrary temperature

scale and in this case it would be difficult to define potential in terms of work done. In the elastic strain field, the potential is simply the extension of the material.

The disadvantage of the normal approach to electric potential is that the concept of its being work done per unit charge makes it very difficult for the student to understand scalar magnetic potential (now that unit poles are out), and virtually impossible for him to ever understand the physical concept of vector potential.

Universal Field Equations

To establish the relationship between flux and p.d. in any field, consider the case of water flowing in a pipe as in Fig. 5. It will be obvious to any student, from everyday experience, that the flux will depend on the following factors:—

(i) The difference in pressure head.
(ii) The cross-sectional area of the pipe (a).
(iii) The length of the pipe (l).
(iv) The viscosity of the fluid. In all fields there is a medium factor (m.f.) which determines how easily flux can be established in a field.

By choosing our units correctly the overall proportionality factor is made unity and thus,

$$\text{Flux} = \left(\frac{\text{m.f.} \times a}{l}\right) (\text{p.d.}) \quad \ldots \quad (1)$$

This is the first universal field equation applying to all field problems. Thus in thermal flow we have:—

$$H = \frac{ka}{l}\,\theta \text{ where } \begin{cases} H = \text{heat flow/sec} = \text{flux} \\ k = \text{thermal conductivity} = \text{m.f.} \\ \theta = \text{temp. difference} = \text{p.d.} \end{cases}$$

and in elastic strain:—

$$F = \frac{Ea}{l}\,\delta \text{ where } \begin{cases} F = \text{force} = \text{flux} \\ E = \text{Young's modulus} = \text{m.f.} \\ \delta = \text{extension} = \text{p.d.} \end{cases}$$

These equations are the basic equations of heat transfer and elasticity respectively. Transposing equation (1) we obtain the second universal field equation:—

$$\frac{\text{Flux}}{a} = \text{m.f.} \times \frac{\text{p.d.}}{l}$$

i.e. Flux density = m.f. × potential gradient .. (2)

This again applies to all fields. Thus in the field of elastic strain we have:—

$$f = Ee \text{ where } \begin{cases} f = \text{stress} = \text{flux density.} \\ e = \text{strain} = \text{potential gradient.} \end{cases}$$

These equations are the basic equations for all field calculations. Equation (1) relates the scalar (magnitude) quantities of flux and potential difference and equation (2) the vector (magnitude and direction) quantities of flux density and potential gradient. By applying equation (1) to a small cylinder, such as cd in Fig. 5, and considering the cylinder to approach infinitesimal size, we can easily obtain the differential expressions for flux density and potential gradient needed in non-uniform fields, namely:—

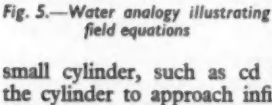


Fig. 5.—Water analogy illustrating field equations

$$\text{Flux density} = \frac{d\,(\text{flux})}{da}$$

$$\text{Potential gradient} = \frac{d\,(\text{p.d.})}{dl}$$

The difficulties involved in the calculation of non-uniform field problems can be illustrated by reference to the cases in Figs. 1, 2 and 3.

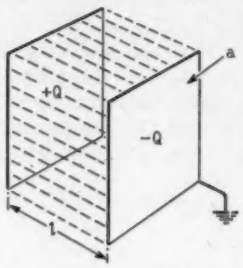


Fig. 6.—Uniform electric field in a dielectric material between a pair of charged plates

These examples are sufficient to demonstrate that all the important features of static electric and magnetic fields can be illustrated by more concrete and familiar everyday phenomena. By spending a considerable time on this work, students can be given a real physical understanding of field concepts before they are called on to consider the more abstract, unfamiliar electric and magnetic cases. This is so important that a start should be made on introducing the more elementary properties of, for example, fields of flow of water during the early science classes in secondary schools. The value of these studies would not be limited to electrical engineering but would give students a new insight into heat transfer, elastic stress, and hydraulic and aerodynamic problems.

Having produced a clear picture of field phenomena, the second major objective of the course in electricity and magnetism is to develop, logically and consistently, an understanding of the behaviour of electric and magnetic fields, and the way in which they interact with materials. This should be based on the first fundamental observation and two further observations, to be made later, embodying the physical interpretation of Maxwell's equations.

It is impossible to outline the complete course in this article and, in the remaining paragraphs, only the essential features of the new approach are described.

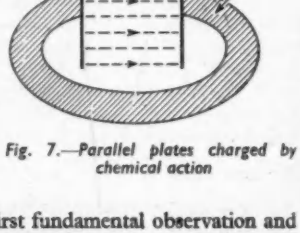


Fig. 7.—Parallel plates charged by chemical action

The method to be followed throughout is to encourage the student to *deduce* the theory on the basis of the fundamental observations, which are made as necessary. The usual historical approach is entirely abandoned. Thus, on the basis of the first fundamental observation and the elementary facts about the electrical nature of matter, the student is encouraged to deduce the descriptive facts relating to charges on conducting bodies, induced charges, polarisation of insulating material and so on. All laboratory work and demonstrations should aim to make fundamental observations or check deductions therefrom. This is the scientific method.

Electric Field in a Dielectric Medium

The measurement of the dielectric field commences with the simplest case, the uniform field between a pair of charged plates, see Fig. 6. There is a very close analogy between the electric field in a dielectric medium and the field of elastic strain and comparison helps to establish a clear picture in the mind of the student.

Referring to Fig. 3 (a), the sequence of events is as follows. A force F is applied to end B which is displaced to the right thus becoming a region of high elastic potential. A field of flux is propagated along the bar in a short time and an equal and opposite force appears at end A. The flux is equal to the applied force and is measured in the same units. The medium is left in a state of elastic strain.

In this case, force is "transferred" through the elastic material, although there is no actual flow.

In Fig. 6, a charge + Q is established on one plate which then becomes a region of high electric potential. A field of electric flux (ψ) is propagated, at the speed of light, and an equal and opposite charge appears on the other plate. The electric flux ψ is equal to the charge Q and is measured in the same unit, the coulomb. The space between the plates is left in a state of electric strain. In this case, charge can be regarded as being "transferred" through the dielectric although there is no actual flow.

Thus the basic equation is established, namely

$$\psi = Q \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (3)$$

Students have, now, no difficulty in deducing the equation connecting flux and electric p.d. (V), namely

$$\psi = \frac{\epsilon a}{l} V = CV \quad .. \quad .. \quad .. \quad .. \quad (4)$$

where ϵ is the permittivity of the medium. By transposing,

$$\frac{\psi}{a} = \epsilon \frac{V}{l}$$

$$\therefore D = \epsilon \mathscr{E} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (5)$$

where D is the electric flux density and $\mathscr{E}$ the potential gradient. Equations (4) and (5) are the universal field equations as applied to this case. Taken with (3) they are the basic equations for all calculations in this type of field.

Having established these equations, non-uniform cases and the other important things such as dielectric strength and so on can be dealt with easily.

Electric Field in Conducting Material

The usual division between electrostatics and current flow is purposely avoided, the two phenomena being treated as the same potential field established in different media. This is essential to a logical development of the subject.

To introduce the field of current flow, the parallel plates are again considered but this time they are charged by chemical action (Fig. 7). An elementary account of the chemical action is given. The field between the plates is, so far, identical with that considered in the previous section.

If a conducting block is slipped between the plates (Fig. 8), the free electrons in the conductor are subject to a force causing them to flow and thus form a new type of flux, the electric current I. The potential and potential gradient $\mathscr{E}$ remain exactly as before.

For this new type of flux the student can easily deduce the universal field equations:—

$$I = \frac{\gamma a}{l} V = GV \quad .. \quad .. \quad .. \quad .. \quad .. \quad (6)$$

and $J = \gamma \mathscr{E}$ .. .. (7)

where γ is the conductivity and J the current density. The normal developments using Kirchhoff's laws, etc., can be pursued from this point.

Referring again to Fig. 8, it is important to point out that, at the instant when the block is inserted, the charges tend to spread over its surface. As fast as they neutralise in the centre, new charge is supplied from the solution and there is a continuous flow of charges along the surface. It follows

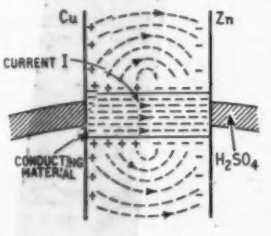


Fig. 8.—A conducting material placed between the plates shown in Fig. 7

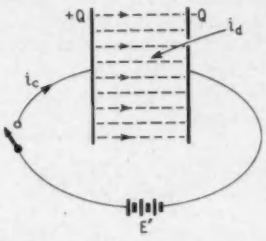


Fig. 9.—A dielectric material placed between charged parallel plates

that there is an electric field, as shown, in the dielectric surrounding the conductor.

Finally in this section, circuits should be considered where part of the circuit is conducting material and part dielectric material (Fig. 9). The instant the switch is closed, a charge begins to build up on the plates and the electric field is propagated between the plates. This propagation of the electric field can be regarded as "transfer" of charge, i.e. a kind of current.

Thus the current in the circuit is

$$i = \frac{dq}{dt} = \frac{d\psi}{dt}$$

It has the nature of conduction current $\frac{dQ}{dt}$ in the wires and dielectric current $\frac{d\psi}{dt}$ in the dielectric.

It should be emphasised that changing electric flux is the form of current that flows in dielectric material and it must be regarded as being a true electric current, equally with conduction current.

The Magnetic Field

The subject will naturally be introduced by a qualitative study of permanent magnets. The use of filings to outline various simple field patterns is a valuable, thought-provoking exercise. The existence of the field of flux is self-evident.

All the previous theory has been deduced from the first fundamental observation. Before proceeding any further it is necessary to make a second fundamental observation.

Second Fundamental

"Whenever an electric field moves, or changes in magnitude, a magnetic field appears in the region occupied by that electric field." This is, of course, the physical statement implied in one of Maxwell's equations. It can be illustrated by rotating a capacitor, moving a charged body, current flow, etc. We can now deduce our magnetic theory from this observation, thus effectively tying the theory of the magnetic field to the electric theory already developed.

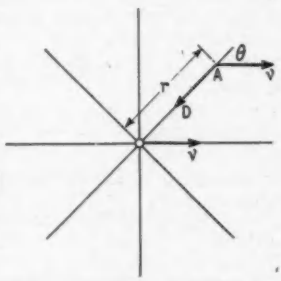


Fig. 10.—Relationship of electric and magnetic fields deduced by considering a moving electron

To do this, consider an electron which, together with its radial electric field, is moving with velocity v as shown in Fig. 10. At any point A, distance r from the electron, a magnetic field exists because the electric flux is moving past A. Students have no difficulty in deducing that the resulting magnetic flux density (B) will depend on the electric flux density D, and the velocity of the electron v. It is also appreciated that, at A, the angle θ between the electric flux and v is significant. Finally, the magnetic property of the medium, the permeability (μ), will be a factor. Simple experiment confirms that $B \propto \sin \theta$ and we have $B = \mu D v \sin \theta$.

As in all previous fields it is to be expected that the

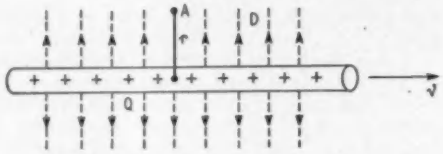


Fig. 11.—From a consideration of a long charged wire moving at a velocity v, the basic equation for a uniform magnetic field can be obtained

magnetic potential gradient (H) and magnetic flux density will be related by

$$H = \frac{B}{\mu} = Dv \sin \theta \quad .. \quad .. \quad .. \quad .. \quad (8)$$

This equation can now be used to establish the expression for the magnetic field around a current carrying conductor and thus the basic equation for the uniform magnetic field. Consider a long charged wire moving with velocity v as shown in Fig. 11 and surrounded by a radial electric field for which

$$D = \frac{Q}{2\pi rl}, \text{ where l is the length of the wire.}$$

$$\text{Thus, } H = Dv \sin \theta = Dv = \frac{qv}{2\pi rl}$$

$$\text{But, } \frac{Qv}{l} = I, \text{ by the definition of I.}$$

$$\text{Therefore, } H = \frac{I}{2\pi r}$$

The magnetic potential (F) around any concentric streamline will be potential gradient multiplied by length of streamline ($2\pi r$).

i.e. $F = I \quad .. \quad (9)$

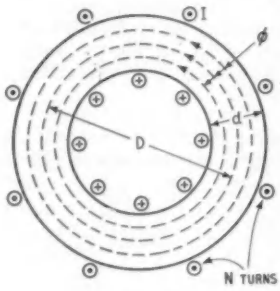


Fig. 12.—Magnetic field inside a toroidal ring

This is the basic equation for the magnetic field, stating that the magnetic potential difference (m.m.f.) around any closed streamline is equal to the current threading through it. It is comparable with the equation $\psi = Q$ in the electric field. It is applicable to any form of current and thus in the case of changing electric flux (dielectric or displacement current)

$$F = \frac{d\psi}{dt}$$

i.e. m.m.f. = rate of change of electric flux linkages (an equation analogous to the well-known $E = \frac{d\phi}{dt}$)

The nearest possible approach to a uniform magnetic field is the magnetic circuit (Fig. 12) and this should be dealt with first. Provided $D \gg d$, it may be treated as a uniform field with little error. Again the student can deduce from experience with previous fields that the magnetic flux (ϕ) and the m.m.f. (F) are related by

$$\phi = \frac{\mu a}{l} F \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (10)$$

Equations (10) and (8) are the universal field equations as they apply to the magnetic field. Practical magnetic circuits may now be considered.

By a procedure almost identical with that used to develop equation 8, Laplace's rule,

$$dH = \frac{I\, dl \sin \theta}{4\pi r^2}$$

can be derived and used for simple non-uniform magnetic fields as usual.

Third Fundamental

To complete the theory, we must now make our third fundamental observation.

"Whenever a magnetic field moves or changes in magnitude an electric field appears in the region occupied by the magnetic field." This observation can be illustrated by the usual simple electromagnetic induction experiments, and is the physical statement implied in the second of Maxwell's equations. By considering a point A near a

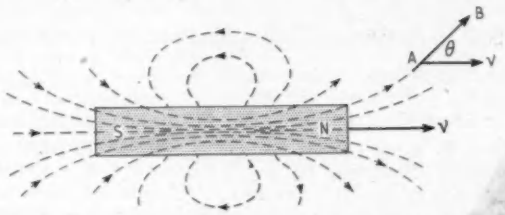


Fig. 13.—Relationship between magnetic and electric fields deduced by considering a permanent magnet

magnet moving with velocity v (Fig. 13), we can deduce the basic equation

$$D = \epsilon Bv \sin \theta \quad .. \quad .. \quad .. \quad .. \quad .. \quad (11)$$

just as we deduced equation (9) previously.

By considering the wire AB (Fig. 14) rolling along conductor CDEF, we can derive the important equations of electromagnetic induction.

Thus the electric field $\mathscr{E}$ in the conductor is

$$\mathscr{E} = \frac{D}{\epsilon} = Bv \sin \theta$$

and the p.d. is given by

$$V = Bvl \sin \theta \quad .. \quad .. \quad .. \quad .. \quad .. \quad (12)$$

Summary of Some of the Equations Obtained

Region under Consideration or Field	Universal Field Equations		Other Field Equations
	Scalar	Vector	
All	Flux = rate of fluid flowing/sec m.f. = medium factor p.d. = potential difference or latent ability	Flux density = Flux per unit area m.f. = medium factor p.g. = potential gradient	
All	Flux = $\frac{\text{m.f.} \times \text{area}}{\text{length}} \times$ p.d.	Flux density = m.f. × p.g.	
Electric field in dielectric	$\phi = \frac{\epsilon a}{l} V$ (ϵ = permittivity)	$D = \epsilon\xi$ $\left(\frac{\psi}{a} = \epsilon \frac{V}{l}\right)$	$\psi = Q$
Electric field in conductor	$I = \frac{\gamma a}{l} V$ (γ = conductivity)	$J = \gamma\xi$ $\left(\frac{I}{a} = \gamma \frac{V}{l}\right)$	
Magnetic field	$\phi = \frac{\mu a}{l} F$ (F = magneto motive force) (μ = permeability)	$B = \mu H$ $\left(\frac{\phi}{a} = \mu \frac{F}{l}\right)$	$F = I$
Relationship between magnetic and electric fields			$\mathscr{E} = \frac{d\psi}{dt}$ $E = \frac{d\phi}{dt}$

Symbols to B.S. 1991 except electric field strength, $\mathscr{E}$.

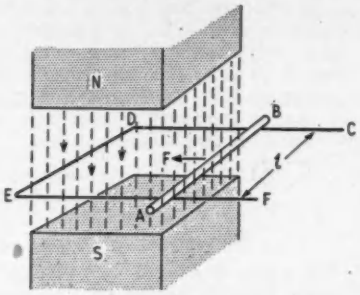


Fig. 14.—From a consideration of the wire AB rolling along the conductor CDEF, equations of electromagnetic induction can be obtained

In moving a distance dx to the left the magnetic flux threading loop BDEA is reduced by

$$d\phi = Bl\,dx$$

$$\text{Thus, } \frac{d\phi}{dt} = Bl\frac{dx}{dt} = Blv = E$$

$$\text{i.e. } E = \frac{d\phi}{dt} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (13)$$

Also the power supplied to push the wire appears as heat in the wire and we have

$$Fv = VI = BlvI \sin\theta$$

$$F = BI\,l \sin\theta \quad .. \quad .. \quad .. \quad .. \quad .. \quad (14)$$

Conclusion

As previously stated, this article concentrates on describing only the main points of divergence from accepted methods. Naturally a tremendous amount of filling-in is required to make the course complete. Again, the aims of the new method are:—

(*a*) To develop an understanding of fields in general by consideration of concrete, everyday field phenomena.

(*b*) To deduce the fundamental theory of electrical engineering from three fundamental observations embodying Maxwell's equations, thus providing a basis upon which all the phenomena of interest to modern electrical engineers can be explained.

The author is prepared to supply a more comprehensive description of his methods on request and would appreciate correspondence from any readers, either directly or preferably through the medium of the *Electrical Review*.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Advertisement Symbols

THE reeent introduction by my company of a new miniature circuit-breaker has been the subject of advertisement in your periodical. Early advertisements featured an acorn and oak tree, and it is felt that inadvertently the use of these devices may have caused confusion amongst your readers as, of course, a tree symbol has long been in use by Messrs. J. A. Crabtree & Co., Ltd., as a registered trade mark for electrical products made and sold by them.

We should welcome the publication of this letter in order to clarify the matter and at the same time to state that we shall not in future use a tree device that may cause confusion between the products of the two companies.

Hungerford, Berks. C. A. F. FULLER-SHAPCOTT,
Managing Director,
Chilton Electric Products, Ltd.

Secondary Battery Improvements

IN his address at the opening of the Electrical Engineers' Exhibition, Lord Brabazon said that " the only electrical items which had not shared in the general advance were primary and secondary batteries, and that if there had been an adequate secondary battery, all of the cars on the road would be electric." It is, of course, easy to criticise the players from a position on the touch-line and, in spite of his broad interests, Lord Brabazon could hardly be expected to be aware of the considerable advances that have been made in storage batteries during the past 20 years or so.

To quote just a few examples of the more usual applications, the lightest aircraft battery of today gives about double the output per unit of weight of its predecessor. Modern batteries for electrically-propelled vehicles are at least 30 per cent lighter and less bulky by the same ratio, than they were 20 years ago, and stationary batteries for special work, such as switch-tripping and so on, give about 2½ times the output in the same volume of their pre-war counterparts.

All of these advances have been obtained without any reduction in life. In fact it is true to say that the working life of lead-acid batteries today is appreciably better than it was 20 years ago. This is due in large measure to recent developments, made by battery manufacturers, in plastic separators, which are much more durable than the older wood separators, and also in improvements in the materials for the containers. But in addition to these, advances have been made in the electrodes themselves, in more corrosion-resistant alloys used for the conducting grids and in the processes of manufacture of the active materials.

Though these advances are perhaps less spectacular than those made in Lord Brabazon's first love, the aeroplane, to the battery user they represent very worth-while improvements. It is perhaps of some significance also that the demand for storage batteries is still steadily increasing.

Though the oil companies may not take the same view, Lord Brabazon's plea for an electric car will strike a responsive chord in many people, particularly storage battery manufacturers, and he may rest assured that the problem of weight is continually under investigation by those engaged in battery research. Unfortunately nature has endowed lead with this objectionable but immutable property, just as she has endowed it with so many others that make this metal almost pre-eminent for reversible electrodes. And it is the insolubility of the reaction product, lead sulphate, which, on the one hand gives these electrodes their high degree of reversibility, and on the other, limits the coefficient of use. Life and capacity per

unit of volume are in fact indirectly related and this applies also to other reversible systems.

The output per unit of weight of the nickel/cadmium battery, for example, is no more favourable. Though the materials are lighter than lead, this is offset by the lower cell voltage of this couple. Much more favourable characteristics are available in the silver-oxide/zinc battery, which gives from four to five times the output for the same weight and volume as the other two systems, but the high cost of silver and the relatively short life of this assembly make it impracticable for use in electric cars.

Electric cars have of course been used with a range of a few miles, but to obtain an endurance comparable with the modern petrol-driven car, seems to call for a revolutionary development in storage batteries. This also raises the problem of rapid recharging, that is, replacing the power in the few minutes that might be taken to refill the petrol tank during a long run, a problem which is probably even more intractable than that of reducing the weight and volume of the battery.

The endurance of the battery could of course be extended by some form of regenerative charging and it is of interest, in this connection, to note that American motor manufacturers have recently announced a project to study the development of an electric car having a power unit which would constantly be recharged during operation by a generator operated by a small auxiliary engine.

As mentioned above, storage battery manufacturers are well aware of the attractions of electric propulsion for cars and are continually looking at the problems involved, but so far no practicable solution has been found.

Clifton Junction, nr. Manchester. M. BARAK, *Director of Research,* Chloride Electrical Storage Co., Ltd.

Competition in Wholesaling

THERE are frequently paradoxes in statements by business men about competition. Mr. Harry Riley's speech at the Electrical Wholesalers' Federation Dinner was an example. He expressed the belief that " normal competitive conditions " will accomplish all that the Restrictive Practices Act sets out to do. But the impending termination of the cable makers' price-fixing agreements, which have presumably restricted competition, is " viewed with extreme regret." Again, we are told, E.W.F. members are concerned at recognition being given to too many wholesale outlets, " many of which do not approach E.W.F.'s standards." But would they not have more cause for concern if the standards of these competitors were equal to or better than those demanded, quite legitimately, by the Federation as a condition of membership?

Last week I met a man who has recently set up as a wholesaler in one of the new towns, where there was previously no wholesaler. Before he could obtain premises the Development Corporation and the Board of Trade had to be satisfied as to his financial position and the local need for this type of business. Nevertheless " recognition " is still refused (on a form letter and without investigation) by one of the principal associations of manufacturers, though not all its members refuse supplies.

We hear much nowadays from large organisations of the threat of uneconomic competition from smaller businesses which perhaps provide less elaborate facilities or concentrate, to start with, on the more profitable lines. Can members of the E.W.F. really complain if someone is sufficiently enterprising to risk his money in supplying a demand that he believes is not being adequately met? In the rapidly growing industrial community of which I speak, where building activity is also at a high level, there was previously no wholesaler nearer than fifteen or twenty miles, and thus there was an inevitable delay or inconvenience in getting supplies. Life may, as Mr. Riley mentioned, have been easier for wholesalers ten years ago but in this area at least it is now easier for the customer. Is that such a bad thing?

London. " CUSTOMER."

Budget Concessions

THE Chancellor of the Exchequer, Mr. Heathcoat Amory, opened his Budget statement on Tuesday by saying that the account he had to give was, he believed, an encouraging one. But the note he wished to sound was not one of satisfaction with past achievements so much as of challenge to the events that now confronted us. Taken altogether we had had a year in which much had been achieved.

On economic prospects at home during the next twelve months, Mr. Amory said that there were unused resources of capital, equipment and manpower which could now be employed productively if the demand was there. Removal of restrictions on hire-purchase had proved a useful and effective method of providing a quick stimulus to this sector of the economy, but he expected that the effects would gradually fall off. The prospect for home production did not represent a full enough use of the capital resources which had been created in recent years and he had therefore thought it right to consider whether further stimulus should be given through the Budget.

The Chancellor then announced that there would be a reduction of 9d in the standard rate of income tax and 6d in each of the reduced rates. These tax changes would become effective on the first pay day after 7th June. He proposed to lighten the weight of purchase tax by reducing the 60 per cent rate to 50 per cent, the 30 per cent rate to 25 per cent and the 15 per cent to 12½ per cent. Replacement television tubes would be freed from purchase tax. These reliefs would come into effect immediately.

Another concession was the restoration of investment allowances in respect of capital expenditure. The rate of investment allowance for the main classes of assets would be 20 per cent for new plant and machinery and 10 per cent for expenditure on construction of industrial buildings. In addition he proposed that the expenditure on new plant and machinery should be eligible for a 10 per cent initial allowance and on industrial buildings 5 per cent.

Printed Wiring Dimensions

THE basic dimensions for the printed wiring used in telecommunication and allied electronic equipment are specified in B.S. 3081: 1959, " Basic dimensions for printed wiring." The requirements specified apply only to printed wiring forming part of a printed circuit, as the standard does not deal with either printed circuits or strip lines for microwave techniques. An appendix gives recommendations on those dimensional aspects of printed wiring for which, in view of the comparatively early stage of development, it is considered unwise to specify rigid requirements at the present time. Recommendations relating to components for use with printed wiring are also given. The content of the standard will be extended as experience is gained in the production and use of printed wiring.

Copies may be obtained from the sales branch of the British Standards Institution, 2, Park Street, London, W.1, price 3s.

VIEWS on the NEWS

By REFLECTOR

A SOMEWHAT unusual book has been passed to me by the Editors. It is by Mr. Harold Horwood, A.M.I.E.E., and bears the title "The Conquest of Time" and the sub-title "Now You Too May Dream True." The author claims to have the useful faculty of predicting the results of horse races by visionary means. He also sets out to give guidance to those who would like to acquire this faculty. He has been successful and has devoted a large part of his gains to charity. My excuse for this mention of the book is that it contains two references to the *Electrical Review*. In 1946 the author sent an anonymous letter to the journal in which he declaimed against the materialism of the age. He said that if the letter were published he would give £100 to the Electrical Industries Benevolent Association and the *Review*, unwilling to deprive the E.I.B.A. of this useful donation, printed it. The second reference falls outside the main theme; it comes under a heading "Astrology, Telepathy and Miracles." Mr. Horwood says that he was once engaged on the calculation of busbar impedances. He found the work very irksome but, by intuition, discovered a simple method of doing the job; this was communicated to the *Electrical Review*. The book is priced at 15s and can be obtained from the author at "Sayani," Slough Lane, Kingsbury, N.W.9.

* * *

An indignant reader draws my attention to a note in a recent issue of *Time* (the American magazine) headed "Light in Yorkshire." This reports a recent case in which a disconnected neutral caused a damaging voltage rise in a Yorkshire village. But the part which seems to annoy my correspondent is a comment upon the multiplicity of types of plugs and sockets and the variety of voltages to be found in this country. Yet the plug situation is one of which we ourselves are fully aware. As to voltage, the Electricity Boards have done much to secure uniformity and odd voltages are rapidly disappearing. The American visitor, *Time* says, finds he has been cunningly outwitted when he tries to use a 110-220 V transformer for an American appliance here; "Britain uses 50-cycle current instead of the 60-cycle found in the U.S." While it is true that the 60-cycle system is general in the United States there are still some 25-cycle and d.c. supplies. The common voltage is 120 but some places are supplied at 110 or 115 V. So even the U.S.A. has not yet achieved absolute uniformity.

* * *

Two Bradford youths recently rifled the electricity meter in the house of a local consumer; they were caught but were not made to pay for the damage and refund the money which they stole. Consequently, the consumer was sent a bill by the Yorkshire Electricity Board for £7 to cover these items. He protested to the local Member of Parliament who took up the case with the Minister of Power. The Minister asked the Board to look into the matter and now, says the *Telegraph and Argus* (Bradford) they have decided not to pursue the matter. But, as Lord Mills pointed out, this must be regarded as a special case because it would be too easy for consumers to remove the contents of meters if they were not held personally responsible for them.

* * *

In a letter to the *Financial Times* the writer asks what logic was behind the "strange decision" of the Weir Committee on gas-electric co-operation that such co-operation could be on only a limited scale. In his strictures he falls into the common error of thinking that "the taxpayer is expected to finance Electricity Boards and Gas Boards." This is true only to the extent that gas and electricity consumers are also taxpayers whereas, of course, the writer had subsidies in mind. So far, neither service has had to seek Government aid, although what may happen in the future in one of the industries I would not care to say.

* * *

I can appreciate the point of view of the electricity consumer who wrote to the *Birmingham Post* recently about a statement that a reduction in charges to industrial users was made possible by the "the high efficiency of the new power stations." He asked

> "Is one to suppose from this that the domestic user, who has had an increase in his charges this quarter, is supplied from specially inefficient stations."

Actually the reduction applies to consumers with coal-clause tariffs and arises from a change in the C.E.G.B.'s bulk supply charge to the Midlands Electricity Board. When coal-price clauses operate in the upward direction—as they usually do—there is no official publicity and so domestic consumers do not realise that they are not immediately affected.

* * *

Sixty years ago, when wireless telegraphy was a novelty, the *Electrical Review* (14th April, 1899) published the following note:—

> "On Saturday last a committee from the General Post Office Telegraph Department went down to the South Foreland to inspect the Marconi system by which messages have been sent across to Boulogne. It is stated that Mr. Marconi will try his system from the Newhaven cliffs to the Dieppe cliffs. It is also stated that the Wireless Telegraphy Company has been approached by the representative of a proposed syndicate which desires to acquire the sole rights of establishing wireless telegraphic communication between England and America. The proposal is understood to be made in all seriousness, and there is every possibility of it being carried to a practical issue if the company and the syndicate can only come to terms. The directors of the company will consider the matter shortly."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. F. H. Last, Ph.D.(Eng.), B.Sc.(Eng.), A.M.I.E.E., technical engineer of the Eastern Division of the Central Electricity Generating Board, has been appointed regional research and development officer of the Eastern, London and South Eastern Region. After training at Queen Mary College, University of London, and the Metropolitan-Vickers Electrical Co., Ltd., Dr. Last joined the Research Department of the Central Electricity Board in 1939. In 1940 he transferred to the Technical Department of the South East England District of that organisation. At vesting date he was appointed senior assistant to the technical engineer of the Eastern Division, British Electricity Authority, becoming technical engineer in 1953.

Dr. F. H. Last

Dr. Last has been the joint author of two papers before the Institution of Electrical Engineers and obtained the Silvanus Thompson Premium in 1944.

Mr. E. W. F. Gillham, M.Sc., Ph.D., F.R.I.C., formerly divisional chief chemist, East Midlands Division, C.E.G.B., has been appointed research and development officer for the Midlands and East Midlands Region. Dr. Gillham, who graduated B.Sc. from London University in 1938, M.Sc. in 1942 and Ph.D. in 1946, was with the Fulham Borough Council Electricity Department from 1946 to 1948 and at vesting date was chief chemist with that undertaking. From 1948 to 1950 he was group chemist to the London Division of the former British Electricity Authority and from 1950 to 1952 was seconded to the Authority's headquarters for work on boiler corrosion. In 1952 he was appointed chief chemist to the East Midlands Division. While at Fulham Dr. Gillham was closely associated with the development of the Fulham-Howden system of flue gas washing at the Fulham station and more recently has been associated with the pilot flue gas washing plant at Nottingham power station.

Mr. S. H. Ball, A.C.C.A., A.M.B.I.M., the divisional accountant of the South Wales Division of the C.E.G.B., has been appointed regional accountant for the Southern, South Western and South Wales Region. Mr. Ball was for three years with the Shropshire, Worcestershire and Staffordshire Electric Power Co. at Birmingham before going to Cardiff where he spent the next thirteen years until the supply industry was nationalised in 1948, with the South Wales Electric Power Co. He was appointed to his post of divisional accountant in 1950.

Mr. H. A. Partridge, at present assistant area manager at Cardiff of the General Electric Co., Ltd., has been appointed south-west area manager in succession to **Mr. H. B. Ducé,** who has retired after forty years' service with the company. **Mr. E. Reeves,** manager of the Installation Equipment Department at Cardiff, has been appointed manager of the Gloucester branch. He succeeds **Mr. I. R. Morgan,** who has retired after forty-four years' service. The Gloucester branch has been transferred to the Birmingham area and the Plymouth branch is now part of the south-west area.

Mr. Partridge joined the G.E.C. in 1929 as a junior in the Engineering Department at Cardiff. After holding various positions he was promoted to assistant district manager of the south-west area in 1949.

Mr. Ducé, who was educated at Adelaide University, joined the G.E.C. in 1919 after serving with the Australian Imperial Forces. He organised important education and welfare work undertaken by the company and then transferred to the sales

Mr. H. A. Partridge

Mr. E. Reeves

side of the G.E.C. at head office. Mr. Ducé went to Cardiff in 1926 and was appointed area manager in 1941.

Mr. Reeves was educated at Gloucester Central School and joined the G.E.C. in 1931 when the Gloucester branch was opened. In 1938 he went to the Witton Engineering Works, and in 1940 joined the Royal Air Force. In 1946 he rejoined the Gloucester branch, remaining there until 1955, when he transferred to the company's Cardiff branch.

Mr. Morgan joined the G.E.C. in 1915 as a representative at the Cardiff branch, later becoming manager of the Osram Department. After service in the Royal Air Force he was appointed manager of the Fittings and Domestic Appliances Department at Cardiff and became manager of the Gloucester branch in 1942.

Mr. E. Lloyd Thomas, B.Sc., A.C.G.I., M.I.E.E., F.R.Ae.S., chief development engineer of R. B. Pullin & Co., Ltd., has been awarded an R.I.C. premium for his article "Analogue Computation."

Mr. R. D. Hamer has been appointed chief executive officer, international sales, in Europe, Middle East and North Africa, for Aluminium, Ltd., with headquarters in Zurich. He was formerly vice-president of Aluminium Laboratories, Ltd., in charge of the Banbury research laboratory and the company's Geneva office. Mr. Hamer has served the company for twenty-three years. From 1943 to 1950 he was business manager of Aluminium Laboratories, Ltd., and has been vice-president of laboratories in charge of the Banbury research laboratory and the Geneva office since 1950. He is a vice-president of the Institute of Metals and a former president of the Aluminium Development Association.

Mr. R. D. Hamer

Mr. E. L. Ashley, manager of the Banbury Works of the Northern Aluminium Co., Ltd., for over 25 years, has been appointed a director of the company. The board has accepted the resignation of **Mr. K. Hall,** assistant director of operations of the parent company Aluminium, Ltd., Montreal, and a director of Northern Aluminium Co., Ltd., since 1946. Mr. Ashley has accepted a special assignment for the company which will take him, in the first instance, to North America. He joined the organisation in 1927 and worked in Britain and Canada before going to Banbury as sheet mill manager in 1931. Two years later he was appointed works manager.

London Transport has appointed **Mr. W. W. Maxwell,** M.A.(Cantab.), as principal executive assistant, with the title of divisional engineer "B," in the Department of the Chief

Mechanical Engineer (Railways). He will be responsible for the railway rolling stock on the Northern and Central Lines and for the preparation of new rolling stock for service. Mr. Maxwell is an associate member of the Institutions of Mechanical, Electrical and Locomotive Engineers.

Mr. R. Alderson has been appointed contracts manager of South Wales Switchgear, Ltd. He will operate from the Blackwood office of the company and be responsible for all contract activities for both transformer and switchgear business. Since 1946 he has held the position of chief sales engineer with the company. Mr. Alderson received his apprenticeship training with A. Reyrolle & Co., Ltd., where for some years he was assistant engineer in the Contracts Department. During the last war he held a commission in the Electrical Branch of the Royal Navy.

Mr. R. Alderson

Mr. A. F. C. Williams, who has been with the British Central Electrical Co., Ltd., since 1955 as personal assistant to the managing director, has been appointed technical sales representative for the north-western area. Before joining the company Mr. Williams was for ten years with the Automatic Coil Winder and Electrical Equipment Co., Ltd. (Avo, Ltd.).

Mr. A. C. Sharpe has been appointed chairman of the Peterborough Branch of the Electrical Industries Benevolent Association, and **Mr. C. H. Johns** has been appointed vice-chairman.

Mr. W. A. Hartop, managing director of George Kent, Ltd., sailed on 2nd April from Southampton on board the *Capetown Castle* for a ten-weeks' business tour covering much of South Africa and the Federation of Rhodesia and Nyasaland.

Mr. J. J. Lee, Graduate I.E.E., author of the article on "Aluminium Strip Windings" (page 667), received his technical education at Wimbledon and Kingston-on-Thames Technical Colleges and served a five-year apprenticeship at Vickers Armstrongs (Aircraft), Ltd., Weybridge, where he was later engaged on aircraft and guided missile work for a number of years in the electrical design office. In 1953 he took up an appointment with De Havilland Propellers, Ltd., Farnworth, Lancs., and was concerned in the design of electrical test gear. Returning to Vickers Armstrongs he continued this work until he was made responsible for the design and development of aerials and radomes on aircraft. He held this position until he left to take up his present appointment as electrical engineer to the Aluminium Development Association in February last year.

Mr. J. J. Lee

Mr. P. T. Appleby, purchasing agent of John Harper & Co., Ltd., has relinquished his normal routine duties after fifty years' service with the company. He will, however, continue to assist the company in an advisory capacity and will also continue his many interests with the Purchasing Officers' Association. **Mr. K. H. Westmancoat,** who has been with the company's Purchasing Department for twenty-two years, has been appointed assistant buyer to **Mr. E. McGill** (director), who has now taken over the control of the Purchasing Department.

Mr. H. Baker, for the past six years Far East regional manager for Marconi's Wireless Telegraph Co., Ltd., has been appointed managing director of Marconi (South Africa), Ltd. Mr. Baker has been with Marconi's since 1930, having joined the company as a student apprentice. During the war he served in the Royal Artillery, attaining the rank of major, and shortly after demobilisation he was appointed manager of Marconi (China), Ltd. In 1951 he became responsible for the whole of the company's activities in the Far East.

Mr. H. Baker

The annual prize-giving of the apprentices of **Kelvin & Hughes, Ltd.,** was held on 2nd April at Barkingside, when Mr. A. Hughes presented the Arthur Hughes prize to Peter R. Launder who had shown in his final year the best ability as a craftsman, and awards to other apprentices. Mr. Hughes mentioned that during the year there had been more than 200 applications for apprenticeship.

The General Electric Co., Ltd., announces the appointment of **Mr. C. S. Griffin,** A.M.I.P.E., as manager of Coldair, Ltd., Wembley.

Mr. Griffin joined Coldair in 1935 and served an apprenticeship. After war service with the Royal Air Force, he was appointed production manager at Wembley and in 1950 became general manager of the newly opened refrigerator assembly works at Portsmouth. On the closing of this works in 1957 he was appointed works manager at East Lane, Wembley.

Mr. N. J. Winnett has been appointed manager of the G.E.C. Appliance Design Centre, Wembley. He entered the company's Magnet Works as a trainee in 1947 and within a year was given charge of the sheathed wire element shop. Later he was sent to the company's Swinton works to manage the solid hotplate shop. In 1948 Mr. Winnett was appointed chief inspector at Swinton. Four years later he took charge of design and all technical matters and was given the title technical manager.

Mr. C. S. Griffin

Mr. N. J. Winnett

Philips Electrical, Ltd., has announced the composition of the board of Cossor Radio & Television, Ltd., following upon the take-over of this company from A. C. Cossor, Ltd. The new directors are **Messrs. A. L. Sutherland, E. W. Brades** and **J. S. Clark. Mr. D. I. Turner,** former sales promotion manager of Cossor, is appointed sales manager. The existing sales force will continue to operate under the present system. For the time being all orders and correspondence should continue to be addressed to Cossor Radio & Television, Ltd., Cossor House, Highbury Grove, London, N.5.

Mr. A. T. Craven, B.E.E., A.M.I.(Aust.), who writes in this issue on "Teaching of Electrical Engineering," was born in Melbourne and during the war served in the Army Corps of Signals, rising to commissioned rank. Subsequently he began a degree course at the University of Melbourne, graduating B.E.E. in 1950. During the course he became convinced that standard methods of teaching electrical fundamentals were unsatisfactory. Since appointment as senior lecturer in electrical engineering at the Royal Melbourne Technical College in 1951 he has had considerable opportunity of experimenting with new methods, leading to the new approach described in his article.

Mr. A. T. Craven

At the recent quarterly meeting of the Commercial Electrical Catering Apparatus Section of B.E.A.M.A. **Mr. W. E. Babb** was elected chairman of the Section for the ensuing year in succession to Mr. Felix A. Rogers, and **Mr. H. K. Tomkins** (Electrical Division, Radiation, Ltd.) was re-elected

vice-chairman. Mr. Felix A. Rogers did not seek re-election owing to his pending retirement from B.E.A.M.A.

Two new British directors have been appointed to the board of the Peace River Power Development Co., Canada. They are **Mr. R. H. R. McGill,** representing the Power Securities Corporation, Ltd., and **Mr. H. F. Akehurst,** representing British Insulated Callender's Cables, Ltd. Both companies are substantial shareholders in the Peace River Power Development Co. Mr. McGill is a director of Balfour Beatty & Co., the chairman of which (Sir Andrew MacTaggart) is also chairman of the Peace River Co.

Electro-Hydraulics, Ltd., has established a new Industrial Hydraulic Sales Department under the direction of **Mr. L. Rumley** (sales director of Electro - Hydraulics, Ltd., and Conveyancer Fork Trucks, Ltd.).

Mr. L. Rumley

A meeting of the **A.S.E.E. Golfing Society** was held recently at Coombe Hill Golf Club. Over forty members and guests took part in a Stableford competition for the G.E.C. Trophy. Mr. P. J. McCardle retained the trophy and Mr. C. E. Boyes was runner-up. The wooden spoon went to Mr. P. Nash and the visitors' prize to Mr. R. Dolomore. Mr. C. E. Boyes (G.E.C.) presented the cup and Mr. W. F. Parker (captain) presented the other prizes. The next meeting will be held at West Herts. Golf Club on 23rd April for the "Brush" Trophy.

The B.B.C. has appointed **Mr. E. W. Hayes,** M.I.E.E., as head of the Planning and Installation Department in succession to **Mr. A. N. Thomas,** A.M.I.E.E., who has retired after thirty-three years' service.

Mr. Thomas joined the B.B.C. in 1926 as an assistant maintenance engineer and after holding various appointments became head of the Planning and Installation Department in 1950.

Mr. Hayes joined the Corporation in 1933 as an assistant maintenance engineer and after service at the Daventry transmitting station, where he became a senior maintenance engineer, he was appointed assistant engineer-in-charge of the Rampisham short-wave transmitting station in 1940 and of the Skelton transmitting station in 1942. He became engineer-in-charge of the Rampisham station in 1945 and assistant to the superintendent engineer transmitters in London in 1946. In 1948 Mr. Hayes was appointed resident engineer, British Far Eastern Broadcasting Service, Singapore. On his return to the United Kingdom in 1951 he was appointed head of the transmitter equipment section of the Planning and Installation Department.

Mr. D. B. Weigall, B.A., A.M.I.E.E., succeeds Mr. Hayes as head of the transmitter equipment section, Planning and Installation Department. He joined the Corporation in 1933 as a student apprentice. He was seconded in 1940 as chief engineer to the Malayan Broadcasting Corporation and returned to the United Kingdom in 1942 when he joined the transmitter section of the then Station Design and Installation Department. He was seconded again in 1943 to become technical adviser on broadcasting to the Ministry of Information. Upon his return to the B.B.C. in 1946 Mr. Weigall was appointed as an assistant to the superintendent engineer studios and in 1948 he was appointed to the Planning and Installation Department as head of the radio section, later re-designated transmitter unit.

Mr. E. R. Deighton is appointed assistant superintendent engineer, television (regions and outside broadcasts), in succession to **Mr. W. D. Richardson,** Associate I.E.E., who is retiring after nearly thirty years' service.

Mr. Deighton joined the B.B.C. Television Service as a technical assistant at the London television station in 1936 after being with the Corporation in Edinburgh for a year in 1933-34. After serving with the Television Outside Broadcast Department from the time of the re-opening of the television service after the war, Mr. Deighton was appointed in 1953 as assistant to the controller, television service engineering.

Mr. G. D. Cook, A.M.I.E.E., is appointed engineer-in-charge (television), Manchester, in succession to **Mr. V. G. Hawkeswood,** who has left the Corporation to take up another appointment.

Mr. Cook has been with the B.B.C. since 1946 and he joined the television service in 1955 when he became assistant to the superintendent engineer television (regions and outside broadcasts).

Mr. T. Davidson has been appointed chief engineer of the Domestic Appliance Division of the English Electric Co., Ltd. Mr. Davidson graduated with a B.Sc. degree in electrical engineering from Glasgow University in 1950. After four years' service in the development laboratories of the Jackson Electric Stove Co., Ltd., he joined the English Electric Co. as senior design engineer responsible for the development of cookers, boiling plates and heating elements.

Mr. T. Davidson

The annual luncheon of the **British Compressed Air Society** was held on 17th March at the May Fair Hotel, London, W.1, when an address was given by Mr. A. G. B. Owen, C.B.E. (chairman, Rubery Owen & Co., Ltd.), on the future role of the British engineering industry in an increasingly competitive world market. At the first meeting of the new Council Mr. E. A. Martin (Padley & Venables, Ltd.) was elected president.

Mr. P. E. Merry, A.M.I.E.E., who contributes an article to this issue on "Electronics in the Plastics Industry," served an apprenticeship with Cadbury Bros., Ltd., in which he gained considerable experience in industrial electrical engineering, while receiving a technical training at the Birmingham Central Technical College. Mr. Merry then gained further experience in the electrical contracting industry on shadow factory installations until the outbreak of war when he served with the Royal Engineers, for most of the time on a C.R.E. staff, serving in Northern Ireland, Africa, Italy and Austria.

Mr. P. E. Merry

After the war Mr. Merry joined the chief engineer's department of Bakelite, Ltd., and took a further course in mechanical engineering at the Birmingham Central Technical College. He was appointed to his present position of electrical engineer to Bakelite, Ltd., in 1950.

Mr. E. A. Webb, sales manager of Winn & Coales, Ltd., left by air on 8th April for the British West Indies, where he will spend about three months with "Denso" agents throughout the area. He returns to London in June.

The ladies' party of the **Electrical Trades' Commercial Travellers' Association** will be held at the Windsor Castle, Victoria Station, London, on 23rd April (6.15 for 7 p.m.). Tickets (19s 6d single and 38s 6d double) can be obtained from the hon. social secretary, Mr. F. J. E. Simons, 42, Lower Barn Road, Purley, Surrey (telephone: Uplands 6078).

The fourth annual dinner of the **South Wales Switchgear Apprentice Association** was held recently at the Park Hotel, Cardiff, when some 300 apprentices together with a large number of guests and ex-student engineers attended; the guest speaker was the Dean of Llandaff, the Very Reverend Eryl S. Thomas, who said that South Wales was immeasurably indebted to Mr. A. J. Nicholas (managing director South Wales Switchgear, Ltd.) for his work in stressing the importance of apprenticeships to meet the expanding needs of industry. In the atomic and nuclear age into

which we had suddenly found ourselves, the demand was for ever-increasing numbers of technically trained men, able to benefit from the discoveries made and put them to the right use. Amongst the other speakers for the evening was Miss Linda Hitchings, who won the award for the best student apprentice in the second year ordinary national certificate electrical engineering course, and who was replying to the toast of the ladies. Mr. N. Care (general manager) presented the awards to the prizewinning apprentices and the evening was concluded with a concert given by members of the Association.

Mr. W. G. Holliday, Lancashire Dynamo Group publicity manager, has been elected a Fellow of the Incorporated Advertising Managers' Association.

OBITUARY

Sir William Robertson Milne, W.S., solicitor of the North of Scotland Hydro-Electric Board since its inception, died at his home in Edinburgh on 31st March at the age of seventy-eight.

Sir Ashley S. Ward, LL.D., president of Thos. W. Ward, Ltd., died on 26th March at the age of eighty-one.

Mr. James F. Smith.—The death occurred on Monday last, after a short illness, of Mr. James Fradsall Smith, B.Sc. (Lond.), M.I.E.E., who had been chief commercial engineer of the South Wales Electricity Board since its inception in 1948. Mr. Smith was born in Cardiff in 1902 and was educated at the University of Wales and the South Wales and Monmouth School of Mines, Treforest. After training at the Penrikyber Navigation Colliery he was for a time with the Powell Duffryn Steam Coal Co. as technical assistant to the chief electrical engineer and then, from 1927 to 1931, with a firm of consultants. In 1931 he became consumers' engineer (industrial) with the South Wales Electric Power Co., a position which he retained until joining the South Wales Electricity Board.

The late Mr. J. F. Smith

Mr. Smith was a Fellow of the Association of Mining Electrical and Mechanical Engineers and was president of the South Wales Branch in 1953. He was also a member of the South Wales Institute of Engineers and of the Cardiff Rotary Club and he served on a number of important national committees. Mr. Smith leaves a widow and a daughter to whom we extend our sympathy.

Mr. G. A. Adams, sales manager of the Engineering Services Division of Geo. Salter & Co., Ltd., died on 29th March. He had been with the company for many years.

Mr. Charles Leonard B. White, district manager for Dorking and Epsom for the South Eastern Electricity Board since 1955, died on 1st April at the age of forty-six.

Mr. White was educated at Brighton College and received his early training in the electricity supply industry with Edmundsons Electricity Corporation—first with the Dorking Electric Supply Co. and afterwards with the Cambridge Electric Supply Co. From 1934 until 1941, when he joined the Royal Navy, he was showroom manager for the Ramsgate & District Electric Supply Co.

On re-entering civilian life he became consumers' engineer for the Ramsgate Company and in 1948 when the electricity supply industry was nationalised he became Seeboard's district commercial engineer for the Thanet District, an appointment he held until going to Dorking in 1955.

Electrical Industries Golf Competition

From now onwards the various area competitions will be held to decide who shall compete in the final of the National Golf Competition for the Sir Montague Hughman Trophy and other awards, to be held on 21st September. The North Western (Manchester) Area Golf Committee is holding its area qualifying competition at the Stockport (Torkington) Golf Club on Wednesday, 6th May, and particulars can be obtained from Mr. J. K. Dean, of the Metropolitan-Vickers Electrical Co., Ltd., Ship Canal House, King Street, Manchester, 2.

Films about A.E.I.

Associated Electrical Industries, Ltd., has some 90,000 stockholders. Because of the obvious difficulty with such numbers of arranging conducted tours, the company has produced a film "Another Name for Power" which shows work in progress at some of its fifty factories. Invitations to see the film at special showings during the next few weeks at the company's new headquarters in Grosvenor Place have been accepted by 2,000 stockholders.

The diversity of A.E.I.'s manufacturing interests is illustrated by the raising of a boiler at the Berkeley nuclear power station, assembly and testing of telecommunications equipment at Woolwich, the assembly of motors at Birmingham and the inspection of fluorescent lamps at Leicester. There are many shots of equipment destined for export, and reference is made to research and development (including the thermonuclear apparatus Sceptre III), on which A.E.I. spends £5½ million a year. The film, which provides an excellent introduction to modern electrical manufacture, is in colour and runs for twenty three minutes.

Graduate apprentices formerly recruited by group management companies are now being recruited by A.E.I., and a second film, "On Course with A.E.I." follows the careers of three boys training to become professional engineers at the company's training centres at Manchester, Rugby and London. There is a welcome emphasis on the need for liberal studies and the importance of getting on with people on the shop floor.

As well as examples of the training provided in typical sandwich courses, the film shows the residential hostels attached to the training centres and the social facilities provided. That a student apprenticeship can lead to the highest positions, is shown by the fact that two A.E.I. directors, five B.T.H. directors and nine Metropolitan-Vickers directors are ex-apprentices.

This film is in black and white and runs for eighteen minutes. Both films are available on loan in 16 and 35 mm sizes.

A student apprentice gaining practical experience on the shop floor of an A.E.I. factory

INDUSTRIAL NEWS

Japanese Nuclear Station Contract

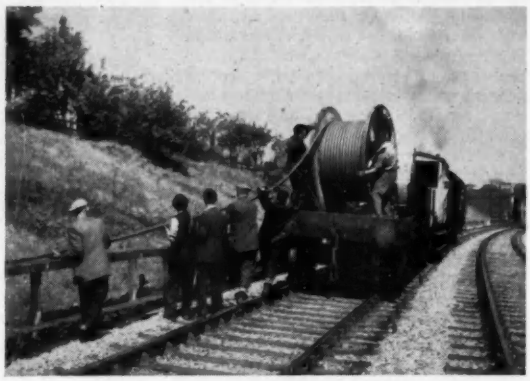
The Japan Atomic Power Company announced in Tokyo on 3rd April that it had issued a "letter of intent" to the General Electric Co., Ltd., for the construction of a 150 MW atomic power station at Tokai-Mura, some 70 miles north-east of Tokyo. This order will be worth in the region of £20 million to the G.E.C. and marks another important step forward for the company. The Japanese company hopes to place the formal contract by 15th July; this date is, however, subject to the Japanese Government's approval.

Reuter reports from Tokyo that Mr. Katsuji Fukuda, executive director of the Japan Atomic Power Company, told a Press conference on 3rd April that the concluding of the contract was subject to the approval of the Japanese Government and the agreement of the U.K. Atomic Energy Authority to supply an adequate amount of uranium fuel. The Authority was expected soon to give its guarantee to supply fuel when it was required.

Mr. Fukuda said he thought the formal contract would be signed by July and that about 30 British engineers would arrive in November to begin building the reactor. The contract price would be several hundred thousand pounds sterling more than the estimate of £18 million because of changes in the specifications.

He added that the Japanese company had given up the idea of seeking a loan from the World Bank to finance the project, and had instead asked the British industrial group for credit, details of which were still being negotiated. Among other points being negotiated was a clause to protect the British builders against rises in the prices of materials during construction.

Other large engineering contracts secured by the G.E.C. during the last month have included an order for two 200 MW turbo-generator sets for the Kincardine station of the South of Scotland Electricity Board, valued at about £4 million, and an order for a complete ore preparation plant for the Redbourn Works of Richard Thomas & Baldwins, Ltd., about £1¼ million.



Telecommunication cable laying in progress on the Crewe-Manchester route of British Railways

Telecommunication Cables for British Railways

British Insulated Callender's Cables, Ltd., has been awarded the contract for further stages in the modernisation of the railway telecommunication system of the London Midland Region. The contract, worth about £250,000, is for the supply and installation of telephone cables on the Crewe-Manchester route and follows the installation by B.I.C.C. of the cables required under phases I and II. This work is associated with the electrification of the route, which is also being largely undertaken by the B.I.C.C. Group, and a type of specially screened telephone cable will be used as in the earlier phases. The cables are sheathed with aluminium and provided with heavy steel tapes for electromagnetic screening against induction from the 50 c/s a.c. traction system. The use of drawn seamless aluminium sheaths for telephone cables is relatively new and the cables of this type installed on the Crewe-Manchester system are the first to be installed on British Railways. The work called for under the new contract will bring about the completion of the Crewe-Manchester telephone cable system.

Nickel Alloy Exhibition

A private electrical exhibition, "Wiggin Nickel Alloys in the Electrical Industry," is to be staged by Henry Wiggin & Co., Ltd., at the Engineers' Club, 17, Albert Square, Manchester, from 20th to 22nd April.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are those quoted on Tuesday last.

ALUMINIUM ingots	ton £180 0s 0d
COPPER, H.C. Electro	ton £250 17s 6d
Fire Refined 99·70%	ton £249 0s 0d
Fire Refined 99·50%	ton £248 0s 0d
COPPER Tubes ..	lb 2s 5½d
Sheet	ton £280 0s 0d
H.C. wire and strip ..	ton £301 5s 0d
LEAD, English ..	ton £69 7s 6d
Foreign	ton £68 0s 0d
MERCURY	flask £78 0s 0d
TIN, block (English) ..	ton £782 10s 0d
ZINC, G.O.B. Foreign	ton £72 1s 3d
BRASS Tubes (solid drawn)	lb 1s 11½d
Wire	lb 2s 8½d
PHOSPHOR BRONZE Wire	lb 4s 2½d
PLATINUM	oz £28 10s 0d
RUBBER, No. 1 R.S.S. spot	lb 27½d—27¾d

Plasma Arc Torch

A device which provides temperatures up to 30,000 deg F for melting and applying coatings of pure tungsten, molybdenum, zirconium, tantalum, high carbide materials and precious metals has been developed by the Linde Department of Union Carbide International Co. of New York, U.S.A. The basic principle of the Linde Plasma Arc Torch is quite simple; the metal or substance to be worked is prepared in either wire or powder form and is passed through the intense arc that is struck inside the torch. Because of the enormously high heat of the arc, the material passing through

Mr. Tamaki Ipponmatsu, vice-president of the Japan Atomic Power Co., who recently visited this country for negotiations in connection with the proposed nuclear power station for Japan, is here seen with Mr. Arnold Lindley (right), assistant managing director, G.E.C., and Mr. R. N. Millar, director and general manager of the G.E.C. Erith Works

is converted into a fluid or plastic state. It is then carried out of the torch by inert gases flowing at high velocity and is finally deposited on the part being made or coated with such force that a firm bond results.

The choice of wire or power—and there is a separate torch for each—is largely one of convenience or economics. Stainless steel, for instance, is readily available in wire form. Tungsten and the carbide materials, on the other hand, are more usually found in powder form and are regularly used with the powder Arc Torch.

Machinery Merchants' Association

At a meeting convened by the Association of British Machinery Merchants at the Waldorf Hotel, London, on 24th March, there was present a representative cross-section of machinery merchant firms throughout the country. The president of the Association, Mr. H. Vernon, of Thos. W. Ward, Ltd., opened the proceedings by welcoming the delegates, and he outlined the aims and objects of the Association. He emphasised that the new Association was not concerned with recruiting members from the existing specialist organisations in the machinery merchant sphere, but was solely concerned in providing an organisation for machinery merchant firms not at present catered for by a national association. It was unanimously resolved that the organisation should seek incorporation as a company limited by guarantee under the name the Association of Industrial Machinery Merchants, Ltd. The secretary is Mr. C. W. Allen, 100, Park Street, Grosvenor Square, W.1 (telephone: Mayfair 7086).

Bids for American Power Project

According to the *Financial Times*, the English Electric Co., Ltd., has underbid its nearest United States competitor for a U.S. Army Corps of Engineers hydro-electric project by over 12 per cent. Tenders were submitted for four 36,111 kVA waterwheel generators at Barkley, Kentucky. The English Electric's bid was $4,496,746. The next lowest bid was $4,785,120 by the Brown Boveri Co., of Switzerland, and the third was by the American General Electric Co., at $5,294,309.

Nuclear Power in Australia

"Exploratory" talks have recently taken place between Sir Thomas Playford, the Premier of South Australia, and Sir Leonard Owen, managing director, Industrial Group, United Kingdom Atomic Energy Authority. The Adelaide correspondent of *The Times* says that Sir Leonard Owen had undertaken to obtain up-to-date information on two aspects of nuclear power: first, the cost and performance of a medium-sized station to operate in South Australia from 1962, and, secondly, what opportunities would be available in Great Britain for training South Australian technicians.

Sir Leonard Owen said that the production of nuclear power might be too expensive for the State for some years; it was a matter of economics. Nuclear stations became more efficient as they increased in size and it was possible that Australia might not need stations big enough to be economically attractive.

Chinese Scientific Literature

The lending library unit of the Department of Scientific and Industrial Research is now collecting Chinese scientific literature, and about 150 Chinese periodicals are being regularly received. Already the unit has a large collection of Russian literature, which is available through a loans service to research, industrial and other organisations. A scheme is in operation for the translation of Russian literature, in collaboration with the National Science Foundation in the United States, which may be extended to include scientific literature from China.

The unit in London is the nucleus of the new National Lending Library for Science and Technology which will be set up at Thorp Arch, near Boston Spa, Yorks, in 1961.

New Submarine Telephone Cable

An agreement has been reached between the United Kingdom Post Office, the Danish and Icelandic Administrations and the Great Northern Telegraph Co. for the laying of a submarine telephone cable between Scotland, the Faroes Islands and Iceland. The United Kingdom Post Office will be joint owners with the Danish Administration and the Great Northern Telegraph Co. of the section of the cable between Scotland and the Faroes. The new cable will provide about 20 telephone circuits as well as a large number of telegraph circuits. It will improve telephone communication with Iceland and the Faroes and make it possible to establish telex services with these countries. Some of the circuits will be used by the civil aviation authorities in connection with the control of the transatlantic air routes. Orders for the cable, repeaters and the associated equipment (valued at about £1,000,000) have been placed with Standard Telephones & Cables and it is expected that the cable will be in service before the end of 1961. The total length of the cable will be 684 nautical miles. Apart from the shore ends, the two cable sectors will be laid by P.O. c.s. *Monarch* beginning in September, 1961.

Cable Price-Fixing to End

At the recent annual dinner of the Electrical Wholesalers' Federation the president, Mr. H. Riley, mentioned that price-fixing agreements in the cable business were being ended. The Rubber and Thermoplastic Cable Manufacturers' Association and the Mains Cable Manufacturers' Association have now announced that their Councils have decided to terminate their price-fixing arrangements on 30th April.

The R.C.M.A. has announced an increase in the prices of mineral insulated cables as from 7th April.

Metal Industry Handbook

The 1959 edition of the "Metal Industry Handbook and Directory" is now available from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1, price 21s net (by post 22s 9d). This directory is in its 48th year of publication and it is recognised as a standard work of reference for all engaged in, or connected with, the non-ferrous metal industries. Up-to-date information on the properties of the newer as well as the more familiar metals is given, and the directory of buyers consists of producers, stockists and factors of all basic metal products, metal working machinery and tools, and metal finishing equipment. The directory is issued free to all subscribers of *Metal Industry*.

English Electric Acton Depot

The new London depot of the English Electric Co., Ltd., at Acton Vale is now in full operation. It covers over 25,000 sq ft of floor space and gives a service and spares coverage over the Greater London area and

The new workshops of the English Electric Acton Vale depot

the south from Lyme Regis to the Wash. The workshops are equipped for rebuilding and respraying of apparatus, as well as routine servicing.

The "Electrical Age"

A considerable improvement has been made in the *Electrical Age*, the quarterly journal of the Electrical Association for Women, which is edited by Miss P. J. Thompson, B.A. The first of the new series is of larger format (about 7¼in by 9½in), it has a pictorial cover and a brighter layout has been adopted for the articles and reports. The contents include several illustrated articles of general interest as well as notes on the construction and use of electrical appliances. The price has been raised to 9d (annual subscription 3s plus postage).

Anglo-Czech Trade Agreement

Discussions have now been concluded between representatives of the United Kingdom and Czechoslovak Governments for new quota lists for the calendar year 1959. The new quotas are the same as those for 1958 and provide opportunities for trade in the goods listed at annual rates of up to some £4·4 million for United Kingdom exports and up to some £6·4 million for Czechoslovak exports.

First Aid and Safety Trophies

The *Western Daily Press* challenge cup for the most outstanding achievement of the year by a member or members of the staff of the South Western Electricity Board has been won by the Bristol Electricity Division of the St. John Ambulance Brigade. The trophy was presented on 2nd April by Mr. A. N. Irens, chairman of the Board, to Superintendent B. P. Taylor, who received it on behalf of his colleagues, at a ceremony at Electricity House, Bristol.

The trophy for the best safety record of the year has been won by the East Devon District of the South Western Electricity Board. The trophy was presented to the winners at Exeter on 6th April by Mr. A. N. Irens, and was received by Mr. F. Richardson, the Board's Exeter district manager, on behalf of the winners.

Hurseal in Manchester

The Hurseal Heating Group (229, Regent Street, London, W.) announces an "at home" in Manchester to members of the heating, architectural and electrical trades at the Grand Hotel, Aytoun Street, Manchester, 1, from 2 p.m. to 8.30 p.m. on 15th April and 10.30 a.m. to 3.30 p.m. on 16th April. The evening session, 6 p.m. to 8.30 p.m., will be devoted especially to the electrical trades. A wide variety of thermostatically controlled electric oil-filled safety radiators and the new "Towel-Rads" will be on show.

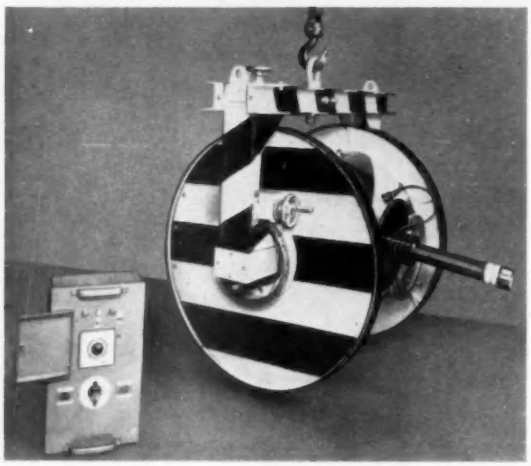
The new, slim 2 kW "Radiant" convector has a 3-heat switch and fold-away handle situated at the back, leaving the front smooth and unbroken. Other exhibits include the "Dampa" lightweight acoustic ceiling, insulating, draughtproofing and weather stripping materials and venetian blinds.

Some of the innovations will be described by Mr. A. C. Hazel, managing director of the Group, who will also recount some of the trends in heating and insulating in the United States and Scandinavia.

Cobalt Radiography

A cobalt container which, with a source of 1,500 curies, is believed to be the most powerful in industrial use in the world has recently been supplied by Newton Victor, Ltd., the X-Ray Department of Metropolitan-Vickers. It will be housed in a specially constructed concrete building in the Darlington factory of Whessoe, Ltd., and used for the radiographic examination of welded seams in steel plate up to 5in thick.

Newton Victor cobalt container for radiographic examination of welded seams



In addition to its inherent reliability, it is largely independent of electrical and water supplies and is thus particularly suitable for work on large construction sites.

The source is housed at the periphery of a disc which moves through 180 deg from the "protected" to the "exposure" position. Adequate clearances are possible without any loss of protection, as the source wheel is, in all positions, totally surrounded by the lead and heavy metal protective shield. During the setting up of the container, a simple but powerful light projector is used to indicate the position of the beam on the specimen at distances up to 20ft (600 cm). An exposure is initiated by pressing a button; the source moves from the "protected" to the "exposure" position and starts the synchronous motor timer which has a range of one second to 55 minutes in steps of one second. Signal lamps indicate the position of the source at all times.

Transistor Exhibition

Applications for tickets for the International Transistor Exhibition, which is to be held at Earls Court from 21st to 27th May, should be sent to Industrial & Trade Fairs, Ltd., Drury House, Russell Street, London, W.C.2.

Bosporus Crossing

The 154 kV transmission line from East to West Turkey is linked across the Bosporus by a 91/0·1214in aluminium steel reinforced overhead line conductor between Umraniye and Silihtar—a distance of approximately 11¾ miles. The conductors were manufactured by British Insulated Callender's Cables, Ltd., and consist of 37 steel wires surrounded by 54 aluminium wires.

E.A.W. Activities

The E.A.W. London Branch held its silver jubilee luncheon and annual general meeting on 10th March, when the chief speaker was Dr. T. E. Allibone (director, Associated Electrical Industries Research Laboratory). The branch chairman, Mrs. F. Dartnall, presided, and other speakers included Miss Mary George (director); and for the London Branch, Mrs. G. Harrap, Mrs. M. Clarkson and Mrs. A. Tingle.

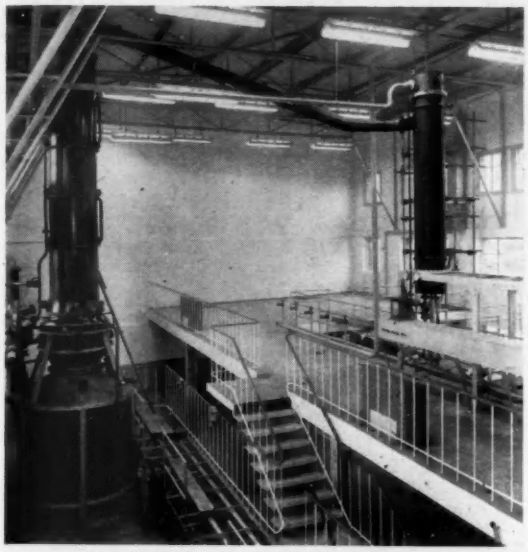
The Association is holding a one-day conference on the teaching of electrical housecraft on 2nd May at Carlisle Technical College, with the co-operation of the Cumberland Education Committee, the City of Carlisle Education Committee, and the North Western Electricity Board.

Health Exhibition

The theme of the Electrical Development Association's stand at the Royal Society of Health Exhibition at Harrogate (27th April to 1st May) will be "Nuclear Power to Clear the Air." A series of display panels employing text, photographs and examples of actual equipment will show how electricity can simplify the task of complying with the Clean Air Act, and how it can be used to advantage in new buildings.

Plant for Guernsey Electricity Board

The States of Guernsey Electricity Board has placed a repeat order with Mirrlees, Bickerton & Day, Ltd., Hazel Grove, Stockport, a member of the Hawker Siddeley Group, for two 2,200 kW diesel generating sets. Each of these sets comprises a Mirrlees



The new still house nearing completion at James Burrough's London distillery

KVSS12 type industrial diesel engine developing 3,096 b.h.p. at 428 r.p.m. direct coupled to an alternator of Brush Electrical Engineering Co., Ltd., manufacture.

New Gin Distillery

At a total cost in the region of £500,000, including plant and equipment, an existing building in Montfort Place in South London is being converted for use as a distillery for James Burrough, Ltd. The new distillery will provide a total floor area of about 75,500 sq ft and the production schedule provides for twelve stills with a potential output of 10,000 gal per day. At present, James Burrough export 90 per cent of their total production.

Three floors of the old building have been removed and additional steelwork installed within the shell to third floor level. This area will accommodate the new stills and has a 38ft head space to the new roof for the tops of the rectifying columns. The third floor level of the building will also house the distillers' control platform.

The bottling hall will have three bottling lines, one being fully automatic with an output of 300 dozen bottles an hour and the other two semi-automatic with an output of 75 dozen an hour. The bottles will be fed automatically by conveyor from a "Miller-Hydro 300" bottle-washing machine.

To provide the steam for the distilling, heating and hot water systems, a new Babcock & Wilcox "Steamblock" No. 400 oil-fired boiler with a rating of 10,000 lb/hr of steam, has been installed. Water is drawn from the firm's own well below the distillery and a 30,000 gal capacity water storage tank is being installed on the roof of the still house.

Electricity is mainly used for the operation of the extensive conveyor system. The main incoming fuse switch is rated at 400 A and this feeds a 100 A circuit to the bottle washing department, a 100 A circuit to the bottling department and a 200 A circuit to the boiler house. Other circuits are provided for lighting and lifts.

To provide a check on the number of cases passing out of the bottling department, a transistorised photo-electric cell counting apparatus is being installed by the Electronic Machine Co. A Radiovisor smoke density indicator has been installed in the boiler house.

The layout of the plant has been designed by Mr. Norman Burrough, production director, in collaboration with the architects, Messrs. Douglas & J. D. Wood, F.F.R.I.B.A. The main contractors for the building are Marshall Andrew & Co., Ltd., and the electrical installations are being carried out by Drake & Gorham (Contractors), Ltd.

Educational

Under a scheme for the interchange of British and Dutch lecturers, the University of London has arranged for Professor B. D. H. Tellegen, of Philips Research Laboratories, Eindhoven, and Professor of Electricity and Electronics, University of Delft, to give two lectures in London. On 29th April (5.30 p.m.) he will lecture on "The Gyrator as a Network Element" at King's College, Strand, W.C.2, and on 30th April (at the Imperial College of Science and Technology, South Kensington, at 5.30 p.m.) his subject will be "The Search for a Complete Set of Ideal Non-Linear Network Elements." Admission to both lectures is free, without ticket.

Calendar

The Eyre Smelting Co., Ltd., has sent us a calendar (April to March), with two-monthly sheets bearing pictures of sporting events; there is also a diary of sport for the year.

Price Reductions

Substantial price reductions are announced for Crompton Parkinson "Tachogenerators." The list price of the standard foot and flange-mounting patterns is reduced from £17 10s 6d to £14 19s; the foot-mounting pattern with 1 : 4 step-up gearbox is reduced from £31 12s 2d to £26 18s. The prices of C.P. "Tachometer" indicators remain unchanged.

Change of Address

The Combustion Engineering Association is moving on 20th April to 70, Jermyn Street, London, S.W.1 (telephone: Whitehall 5536).

British Trade Fair, Lisbon

The telecommunications equipment being sent to the forthcoming British Trade Fair in Lisbon by Standard Telephones & Cables, Ltd., will cover the whole field of telecommunications from basic components to complete systems.

Trade Announcements

The **Baldwin Instrument Co., Ltd.,** has appointed the following agents and technical representatives:—Scotland: Sales and Service and Technical—James Scott & Co., Ltd., 68, Brockville Street, Carntyne Industrial Estate, Glasgow, E.2 (telephone: Shettleston 4206-9). North of England: Sales and Service—W. Don & Partners, Ltd., Crown Works, Crown Point Bridge, Leeds, 9 (telephone: Leeds 33781-2); Technical representative—Mr. J. D. Thornley, Waterhey Cottage, Rivington, nr. Bolton, Lancs. (telephone: Horwich 364). Midlands: Technical representative—Mr. P. Lawrence, 16, Hawthorn Road, Kings Norton, Birmingham, 30 (telephone: Kings Norton 4476).

Petbow, Ltd., have appointed Messrs. K. Glensey, I. D. Cockerell and J. L. Rummins as technical sales representatives. Messrs. Glensey and Cockerell will represent the company overseas whilst Mr. Rummins will be based in London.

Phœnix domestic appliances are now marketed by **Phœnix Appliances, Ltd.,** instead of by Phœnix Sales, Ltd., and H. Kaufmann, Ltd., have ceased to act as selling agents in relation to these goods. Phœnix Telephone & Electric Works, Ltd., the manufacturers, state that this change in no way reflects on H. Kaufmann, Ltd., but is intended to put it in sole and direct control of the marketing of its own goods.

The telephone number of **Enfield Cables, Ltd.,** Brimsdown, has been changed to Howard 2468.

The Electrical Wholesale Department of **Taylor & Parsons, Ltd.,** Bradford, has been transferred to the parent company, Rycroft & Co., Ltd., Ryco Works, Tetley Street, Thornton Road, Bradford, 1. The change is basically a matter of centralisation of the group wholesale departments and the staff of the Electrical Department of Taylor & Parsons has joined Rycrofts in the same capacities.

Ekco-Ensign Electric, Ltd., announces that Mr. A. Newman has joined its northern area sales staff as a sales lighting engineer.

Electricity Supply in Europe

Organisation for European Economic Co-operation Report

THE levelling-off of economic activity in Europe during the past two years had little effect on the consumption of electricity. According to the latest report prepared by the Electricity Committee of the Organisation for European Economic Co-operation ("The Electricity Supply Industry in Europe 1956-1963," price 5s) consumption rose by 6·5 per cent in 1957 and probably by about the same percentage last year. This continuing expansion, practically unaffected by present economic conditions, reflects a more intensive use of electricity in all sectors.

During the next five years the demand for electricity should go on increasing by about 7 per cent a year and by 1963 ten to twelve large nuclear power stations should be in commission with a total capacity of around 3,250 MW.

The total capacity of power stations in Europe in 1957 was 109,941 MW, 7·3 per cent more than in 1956, and since it is expected that this rate of increase will be maintained, the total capacity in 1963 should have reached 161,600 MW. The proportion accounted for by hydro plant is expected to fall from 37 per cent in 1957 to 35·8 per cent in 1963, but this decline will be offset to some extent by the first nuclear stations. Specific fuel consumption in power stations, which in 1957 was 3,371 kcal/kWh, with a thermal efficiency of 25·5 per cent, should fall by 1963 to 3,048 kcal/kWh, giving a thermal efficiency of 28·2 per cent.

Production of electricity in all O.E.E.C. countries combined is expected to rise from 410,641 million kWh in 1957 (257,491 thermal and 153,150 hydro) to 618,050 million kWh in 1963. Coal is still the main fuel used in thermal power stations, but by 1963 some 10 per cent will be fired with fuel oil. Natural gas and brown coal are also gaining ground at the rate of 9 per cent and 11·7 per cent a year respectively.

The average annual increase in consumption during the next few years is estimated at 9·5 per cent for agriculture, 8·4 per cent for lighting, 7·4 per cent for domestic consumers, 6·6 per cent for industry, and 5·3 per cent for traction. For Europe as a whole the average power consumption per head amounted to 1,144 kWh in 1957 (4,200 kWh in the United States) and it will probably rise to 2,042 kWh by 1963.

Investment by Electricity Undertakings

Detailed figures of O.E.E.C. countries' investment in the production, transmission and distribution of electricity, which are included for the first time, show that electricity supply undertakings, including "autoproducers," invested $3,402·6 million in 1957, which was 7 per cent of the "gross fixed capital formation." This should have increased to $4,200 million by about 1961. Nuclear plants will then account for 10 per cent of total investment in Europe as a whole and 27 per cent (the highest individual percentage) in the United Kingdom.

The report contains nearly a hundred pages of tables giving figures for each of the years 1956 to 1963 for each of the O.E.E.C. countries and in some cases also for Spain and Yugoslavia. The tables include, for both public and private generating plants, statistics relating to plant capacity and output, maximum peak capacity, consumption by groups of consumers, output according to type of fuel used, and investment.

Rural Electrification

Some years ago the Committee on Electric Power of the Economic Commission for Europe decided to undertake a study of rural electrification. The purpose was to make available to the less industrialised countries the results obtained in countries which had been dealing with such problems for a long time, and also to give European countries an opportunity of comparing their experience in this field.

Two volumes containing ten and six reports respectively on "Rural Electrification" have already been published, and volume 3 containing a further eight reports is now available, price 11s. The reports in this volume are by authors in France, Poland, Russia, Italy and Bulgaria. Among the subjects dealt with are the link-up of small hydro plants in local networks, low and medium capacity thermal plants for combined production of power and heat, methods adopted in various countries to prevent excess voltage of atmospheric origin in low and medium voltage networks, and the application of electric power to farm transport. A statistical survey of progress in rural electrification in various European countries shows the average consumption by rural consumers to be generally less than 1,000 kWh per year. In the United Kingdom the average annual consumption by rural consumers is 6,000 kWh and in the United States it is up to 6,500 kWh, or higher than the average of urban consumers.

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330 kV Oil-Filled Cable Installation

AT the T1 power station of the Snowy Mountains Hydro-Electric Authority, Australia, Pirelli-General Cable Works, Ltd., has now completed the installation of one of the first 330 kV oil-filled cables to be supplied by a British manufacturer. The installation consists of seven single-core cables with a capacity of 340 A per phase, grouped in two three-phase circuits with one spare cable, terminations and all ancillary equipment.

The cables, ranging in length between 507 and 543 yd, were pulled from the switchyard end and laid at 1ft centres in sand-filled troughs in the floor of a tunnel. As the switchyard is on the opposite side of the Tumut River to the power station, a special bridge has been erected on which the cables are laid. Special arrangements have been made to control the expansion movements of the cable on the bridge due to seasonal variations in temperature.

The assembly of the outdoor terminals in the switchyard and the connections to the oil-feeding pressure tanks presented no special difficulty, but the insertion of the oil-immersed terminals in the transformer connecting chamber involved considerable problems in manipulation. The connecting chambers were filled with oil degasified on site to a condition similar to the oil contained in the cable.

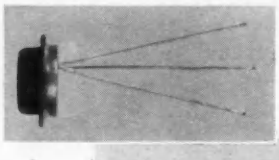
After installation, each cable was successfully tested at 760 kV d.c. for 15 minutes using a 1,000 kV transportable testing equipment designed and manufactured for Pirelli-General by Ferranti, Ltd.

Components for the Radio and Electronic Industries

THE R.E.C.M.F. EXHIBITION REVIEWED

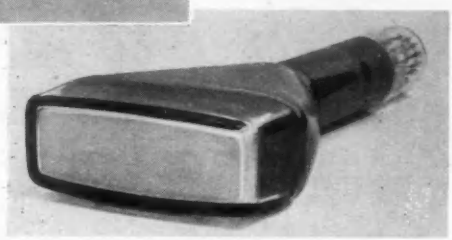
REDUCTION in size was a general feature of the items displayed at the sixteenth exhibition of the Radio and Electronic Component Manufacturers' Federation held this week at Grosvenor House and Park Lane House, London. The 179 firms exhibiting showed products for all branches of communication and electronic engineering, from individual components to complete equipment and test apparatus. The steady increase in exports of the electronic industries' products has continued. In 1958 equipment and components valued at £21 million were shipped overseas, 5 per cent more than in the previous year and 28 per cent more than in 1956, and of this approximately £6 million-worth went to the U.S.A. and Canada.

The possibility of new television channels was forecast by several manufacturers, turret tuners and aerials for use on the frequencies suggested for the first alternative programmes being shown. Several new items have been introduced in the expanding tape recorder market, including a tape which doubles the playing time for a given size spool, and improved record/playback heads which give good response at tape speeds of 3¾in/sec, half the present standard speed. New stereophonic tape decks and record players were shown, and a stereophonic recording microphone comprising two tubular directional microphones which can be turned to the required angle. Plastics



Left: Newmarket intermediate power transistor

Below: A-scan cathode-ray tube produced by the M.O. Valve Co., Ltd.



are being increasingly used, not only in the production of cabinets and containers, but for insulation and as dielectric materials in condensers. Plastic-insulated cables which can withstand temperatures between −65 and +250 deg C are now quite general.

Transistors, Valves and Cathode-Ray Tubes

Among the firms exhibiting for the first time this year was Semiconductors, Ltd., who showed a full range of surface barrier, micro alloy, micro alloy diffused and silicone alloy transistors for both computer and communication applications. Also given on their stand was a detailed description of high-frequency germanium transistor production. The range of alloyed junction p-n-p transistors on the stand of Newmarket Transistors, Ltd., included types for r.f. amplifiers and oscillators, and high-speed switching. Audio transistors for applications requiring a unit with up to 200 mW dissipation, and power transistors with voltage ratings of 15, 30 and 60 V were also shown.

Mullard, Ltd., displayed packages of selected and tested transistors for use in the r.f. and a.f. sections of radio receivers and in a.f. amplifiers. Each package is guaranteed to provide the minimum overall gain figure when used in suitable circuits, and due to the selection the spread in overall gain is much smaller than can be achieved using transistors picked at random. Also shown by Mullard were 21in and 17in 110 deg television tubes, which are substantially shorter than the equivalent tubes currently in use, the 21in tube being more than 8½in shorter than its 70 deg counterpart. These new tubes have metal-backed phosphors, are electrostatically focused and incorporate a straight type of electron gun which dispenses with an ion-trap magnet. Two 110 deg tubes were shown by Siemens Edison Swan, Ltd. A new A-scan tube, 1600G, shown by the M.O. Valve Co., Ltd., has an aspect ratio of 2·5 to 1, and is used for radar and oscilloscope applications where space is limited.

The quartz crystal units on the Salford Electrical Instruments, Ltd., stand covered frequencies between 200 c/s and 19 Mc/s and a packaged oscillator was shown which gives quartz crystal controlled frequencies of 100 kc/s. The B series of temperature controlled crystal ovens shown by Cathodeon Crystals, Ltd., are designed for use with the company's quartz crystals to provide high frequency stability, up to ±0·000001 per cent, sources from 1 kc/s to 100 Mc/s.

The ceramic valves, in which glass has been totally eliminated, shown on the Ferranti, Ltd., stand are of small dimensions. An r.f. oscillator/amplifier shown, capable of operating up to 1,000 Mc/s, has a mean anode dissipation without forced air cooling of 30 W, and a maximum peak power output of 15 kW.

Capacitors

Capacitors adapted for use with printed circuit techniques were to be seen on many stands. Stability Capacitors, Ltd., showed their S.R.C. range adapted to give easy insertion into printed circuits and ensure reliable dip soldered joints, and their insulated silvered mica capacitors and ceramic tubular capacitors were shown with shoulder tag terminations. A range of silvered mica condensers in wax, insulated and moulded forms, with a new printed circuit insulated version, was displayed by the London Electrical Manufacturing Co., Ltd. Other exhibits on this stand included a range of silvered ceramic tubular and disc type insulated capacitors, with new miniature sizes and special types for printed circuit use, a miniature ceramic trimmer and a range of polystyrene dielectric capacitors which has been extended to include

a miniature low-voltage series suitable for transistor circuits.

The Telegraph Condenser Co., Ltd., exhibited a new range of miniature silvered mica capacitors protected by an insulating non-cracking compound affording good humidity protection and suitable for working at temperatures from −70 to +100 deg C. The capacity range extends to 220 pF. The existing ranges of T.C.C. tantalum electrolytic capacitors have been extended, and a new series, for operating at temperatures up to 125 deg C, was shown. Further miniaturisation has been carried out by Daly (Condensers), Ltd., on all types of electrolytic capacitors, with particular emphasis on reversible miniatures for use in loudspeaker cross-over circuits. New dry electrolyte tantalum slug type capacitors were shown, and also electrolytic capacitors up to 20,000 μF at a working voltage of 75 V d.c. in a single unit.

Transformers

A low-cost potted transformer designed to withstand the climatic conditions existing in tropical countries was shown by the Hinchley Engineering Co., Ltd., with a range of standard isolation and auto-transformers provided with fused output voltage selection. Gresham Transformers, Ltd., exhibited their newly type approved hermetically sealed C core transformers using a three-part can assembly, and the "Sepoy" range of transformers and chokes employing heat sinks for use in aircraft, guided weapons, and similar applications. The core of the component is left exposed, making contact with the equipment chassis and giving, by conduction, a greater heat radiating surface. The coils are in cast resin for high humidity resistance.

A comprehensive display of iron-cored components was made by Haddon Transformers, Ltd., including power and audio frequency transformers, chokes and reactors, of open, oil-filled and hermetically sealed epoxide resin-cast construction. Also displayed were saturable reactors giving stepless control of a.c. circuits up to 100 kVA capacity.

Several manufacturers displayed transformer and choke cores and core laminations. Among them were the English Electric Co., Ltd., who also showed a range of C core single-phase and three-phase E core transformers, and the Telegraph Construction & Maintenance Co., Ltd., who exhibited a Y core for three-phase applications. Toroidal cores, using nickel-iron materials made by a powder metallurgy process on high-temperature ceramic bobbins were shown on the stand of Geo. L. Scott & Co., Ltd., who also exhibited high-permeability tapes, down to 0·0003in thick, on ceramic bobbins for switch matrices and other magnetic devices.

Magnetic Materials

The "Eclipse" permanent magnets on the stand of James Neill & Co. (Sheffield), Ltd., included several newly developed types. Among these were small rings of carbon magnet steel, "steering" magnets, which clip directly on to 110 deg television tubes to compensate for gun alignment deviations, a function performed on earlier tubes by the ion trap magnets which are not fitted to these latest tubes. Three designs of C-shaped anisotropic magnets fabricated from heat treated parts by a resin bonding technique, an isolator magnet for waveguides, an eddy-current braking magnet to regulate the falling speed of control rods in nuclear power stations, and a radar magnetron magnet were also shown. Mullard type FX1981 "Feroxcube" cores are incorporated in the latest "Elac" deflection unit which was shown by Electro Acoustic Industries, Ltd., enabling a pull back of 4 mm to be achieved without loss of sensitivity. A range of permanent magnets and a selection of tape-wound grain orientated silicon iron cores was shown by Marrison & Catherall, Ltd., including magnets for magnetrons, travelling wave tube collimators and ferrite isolators.

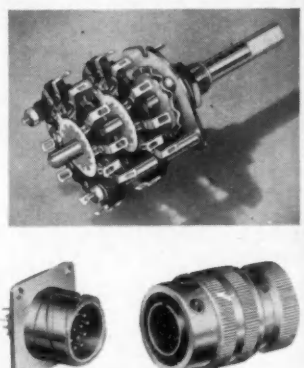
Rectifiers

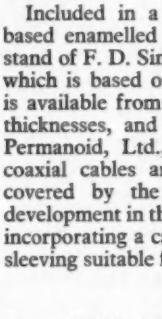
Silicon powder diodes and rectifier stacks incorporating a new h.t. power rectifier for television receivers were shown by Standard Telephones & Cables, Ltd., with selenium stacks for industrial and electronic application. Germanium photo-electric cells for sensing punched cards and perforated tape, and nickel and cobalt iron alloys in the form of toroidal and strip cores were among the other S.T.C. exhibits. Both contact- and convection-cooled metal rectifiers, including a sealed type for use in receivers being exported to countries where difficult climatic conditions have to be met, were shown by the Westinghouse Brake & Signal Co., Ltd.

Cables

Included in a display of synthetic and oleoresinous based enamelled wires and textile-covered wires on the stand of F. D. Sims, Ltd., was "Sim 155," the covering of which is based on a polyterephthalate resin. This wire is available from 8 to 47 gauge in all standard covering thicknesses, and in a wide range of rectangular sizes. Permanoid, Ltd., showed a number of high-frequency coaxial cables and screened leads, including all types covered by the recent B.S. 3040:1958. The latest development in this field is a double-screened coaxial cable incorporating a carbon tape construction. Silicone/glass sleeving suitable for continuous operation in temperatures

Right: The N.S.F.-Oak model JK rotary wafer switch





Above: Painton holder for horizontal valve mounting

Above: Amphenol miniature connector

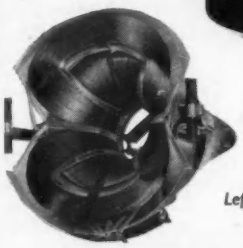
Above: A 2 kVA Haddon saturable reactor

Above: A 7in × 5in elliptical speaker introduced by Reproducers & Amplifiers, Ltd.

Right: The model 4HF Garrard record player

Above: Hinchley Engineering fused output isolating transformer

Left: Rola Celestion two way re-entrant speaker



Left: Electro-Acoustic Industries deflection unit

up to 180 deg C was also shown, with samples of a range of very fine connecting wires using a thin coat of p.v.c. insulation for deaf aid equipments and other small electronic gear. On the Telegraph Construction & Maintenance Co. stand were helical membrane cables for radio and television transmission and microwave links, cellular polythene television downleads providing reduced attenuation, and p.t.f.e. cables developed for use at high temperatures—200 deg C—in aircraft and electronic fields.

Switches and Relays

The model JK, a rotary wafer type switch providing up to 22 contact positions on a single section without using insulated back contacts, and the model A, a miniature rotary switch having an overall diameter of less than 1½in, were among the new N.S.F.-Oak products shown by N.S.F., Ltd. A selection of slide and wafer switches was to be seen on the stand of Walter Instruments, Ltd., including models specially designed for inclusion in printed circuit assemblies, and A. F. Bulgin & Co., Ltd., introduced a new range of toggle switches with push-push successional operation. The Telephone Manufacturing Co., Ltd., showed a new 10-way multiple relay employing a common yoke integral with the mounting brackets, phosphor-bronze contact springs and silver bi-metal contacts. "Diamond H" Switches, Ltd., exhibited the B.R. series of hermetically sealed miniature relays having a four-pole change-over mechanism rated for 10 A at 30 V d.c. or 115 V, 400 c/s a.c.

Connectors and Valve Holders

Two new types of terminal strip, the miniature TS.6 with four to 12 contacts and the TS.7 range with up to 24 insulators, were shown by Wingrove & Rogers, Ltd., and Painton & Co., Ltd., introduced a number of printed circuit connectors including a 15-way plug and socket and a right-angle valve holder permitting horizontal valve mounting. The series of connectors shown by Amphenol (Great Britain), Ltd., included a miniaturised version of the E type MS connector in five shell sizes and 17 insert arrangements. On the Belling & Lee stand was a new 1 A three-pin mains connector in which all connections are clearly visible through a transparent nylon cap.

Batteries

The range of mercury primary cells manufactured by Mallory Batteries, Ltd., were exhibited, including a 38 Ah battery which provides several outputs up to 135 V in a space of only 170 cu in, and the company is developing a cell with a capacity of 37 mAh which will occupy a space of only $\frac{1}{80}$ cu in. A representative range of Leclanché and "Kalium" mercuric oxide cells and batteries were shown by Burndept, Ltd., with nickel cadmium cells and stacks in the 50 and 225 mAh ranges.

Aerials

A wide selection of aerials from both the home and export ranges was exhibited by Antiference, Ltd. New dipole junction units for Band II and Band III models and a new Band III adaptor for attachment to existing horizontal Band I aerials were shown.

A combined range of television aerials having a Band I dipole or dipole and reflector combined with a slot and folded reflectors in the Band III section were shown on the stand of J-Beam Aerials, Ltd., which was shared with their associated company, Radio Telephone Aerial Systems, Ltd., who displayed a new mobile whip aerial and a range of dipoles for marine use, available with a protective covering of three-ply epoxy resin/glass laminate.

Loudspeakers

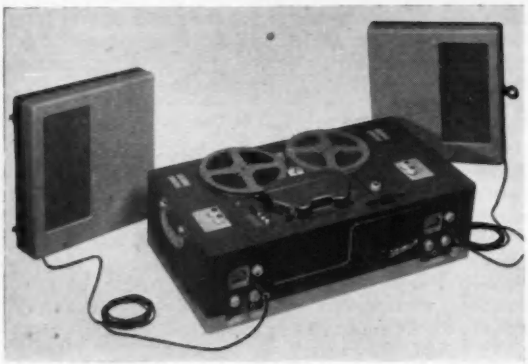
Goodmans Industries, Ltd., showed a new 8in by 3in elliptical shallow depth speaker, and a 3½in high-frequency tweeter with a 1 to 17 kc/s range for use in sound reproducing equipment where the output quality justifies the use of an extended range loudspeaker system. The rear of this unit is totally enclosed to prevent its diaphragm being modulated by pressures set up by any bass unit mounted in the same enclosure.

A new 7in by 5in elliptical speaker was introduced at the exhibition by Reproducers & Amplifiers, Ltd., supplementing their standard range, most of which can now be supplied with duplex cone systems, and Richard Allan Radio, Ltd., introduced a clipped version of their 5 and 7in by 4in speakers and also a new 12in commercial unit. Two new models shown by Rola Celestion, Ltd., were a 2⅝ by 8in elliptical speaker which can be supplied with various flux densities, and a two-way re-entrant loudspeaker of the twin-diaphragm pressure-driven type.

Record Players and Tape Recorders

Examples of record playing equipment manufactured by the Garrard Engineering & Manufacturing Co., Ltd., were exhibited, comprising single record players and automatic record changers, pick-up arms and crystal and moving coil cartridges. The 4 HF unit illustrated is a single record player fitted with the latest TPA12 pick-up arm which will take most present-day cartridges. The a.c. motor is available for 100/130 or 200/250 V supplies.

The No. 700 stereophonic pick-up cartridge which was shown at the exhibition for the first time by the Goldring Manufacturing Co. (Great Britain), Ltd., is a four-pole balanced armature magnetic cartridge fitted with a 0·0005in tip radius diamond stylus. Another new exhibit was the Goldring No. 300 cartridge, a high power magnetic cartridge suitable for use in tropical climates. A special version has been designed for use with transistorised amplifiers, giving an output of 80 microwatts when



Left: The "Reflectograph Stereacorder" shown by Multimusic, Ltd.

Above: Dawe impedance comparator

Left: Whiteley cable test set

feeding into a transistor load of 1 kΩ. Staar Electronics showed a new six-pole battery-operated d.c. motor which runs at a constant speed of 1,810 r.p.m. Also displayed was a battery-operated 45 r.p.m. record player, operating at 6 V with a current consumption of 41 mA.

Wright & Weaire, Ltd., displayed the Series 4 range of "Ferrograph" magnetic tape recorders and accessories. The basic instrument in this series is the model 4 A/N, which has provision for the fitting of a second head, enabling any facility to be added to those given by the basic instrument. Collaro, Ltd., exhibited a new tape deck, the "Studio," a single-track single-direction machine with three tape speeds, $1\frac{7}{8}$, $3\frac{3}{4}$ and 7in per sec. Space for a third head for stereophonic operation is provided, and a three-digit counter is employed for tape position indication.

The full range of tape recording equipment produced by Truvox, Ltd., was shown, including the new Mk VI tape deck and an improved version of the type K amplifier, known as the Mk II. Multimusic, Ltd., a subsidiary of Multicore Solders, Ltd., showed a continuously playing tape reproducer, the "Reflectograph Stereacorder," which automatically reverses on a short metal foil strip at either end of a standard recording tape. The range of "Scotch Brand" magnetic tapes and accessories shown on the Minnesota Mining & Manufacturing Co., Ltd., stand, included the new No. 200 double play tape manufactured from tenailised polyester film and available in 400, 1,200 and 2,400ft reels.

A universal impedance bridge, exhibited on the stand of British Physical Laboratories, Ltd., measures values of resistance, inductance and capacitance. For resistance measurement it is connected as a Wheatstone bridge and the out-of-balance voltage is amplified by a chopper amplifier and indicated on a 4in meter fitted with automatic overload protection. For capacitance measurement the instrument is arranged as a modified De Saute's bridge, with null detection by a tuned amplifier-detector, and for measurement of inductance it is connected as a Hays bridge, the reactive standard consisting of a silvered mica conductor.

A cable test set, shown by the Whiteley Electrical Radio Co., Ltd., can accurately locate the position of breaks or short circuits in multiple conductor cables. An a.f. voltage is applied between one end of the conductor and earth and a capacitive probe detects the electrostatic field up to a break in the conductor while an inductive probe detects the electromagnetic field up to a short between conductors. For initial determination of a faulty conductor a lamp type continuity tester is provided, and conductors other than the faulty one are earthed.

Among the exhibits on the Dawe Instruments, Ltd., stand was the newly developed type 304 direct reading impedance comparator which enables up to 2,000 inductors, condensers and resistors to be checked per hour. Ranges with deviation measurements are 10 Ω to 6 MΩ resistance, 100 pF to 10 μF capacitance and 2 mH to 100 H inductance.

The increasing use of plastics, laminated and other mouldings in the electronics industry was exemplified by the products, ranging from terminal blocks and coil formers to complete radio cabinets, exhibited by Ekco Plastics, Ltd., and the radomes and radar reflectors manufactured from glass reinforced materials on the stand of Thermo Plastics, Ltd., while the Standard Insulator Co., Ltd., showed moulded rubber masks for industrial cathode-ray tubes.

A coil winding machine to produce layer-wound coils with no interleaving medium was shown by Avo, Ltd., and a precision brazing equipment for silver soldering fine wires was demonstrated by Electrothermal Engineering, Ltd.

The Federation has announced that in future the Exhibition will take place biennially and will be held at Olympia.

Insulating Oil

A NEW electrical series Code of Practice, C.P.1009 (1959), deals with the maintenance of insulating oil—including inhibited oils—supplied to B.S. 148 and intended for use in transformers, switchgear and certain other oil-immersed electrical equipment. Oil is subject to deterioration or contamination in storage, in the course of handling, or in service, and may therefore require periodic treatment to maintain its properties, or, eventually, need to be replaced by new oil. This code describes the nature of the possible deterioration and recommends routine methods of sampling and testing. From this information it is possible to determine whether the oil is suitable for further service and, if not, whether the treatment recommended should be used or the oil replaced.

The tests recommended are as simple as possible and due regard has been given to the difficulties of testing on site. Although the recommendations relate mainly to oil used in switchgear and transformers, they also apply to certain other apparatus, e.g. oil in rectifiers, which can be treated in the same manner as oil in transformers. The recommendations do not apply to oil in capacitors.

Copies of this code may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price 6s.

The author surveys the established applications of electronics for process control of the manufacture of plastic materials. Probable future applications are also discussed including the use of computers based on the automatic chemical analysis of materials

Electronics in the Plastics Industry

Survey of Present and Future Applications

By P. E. MERRY, A.M.I.E.E., A.M.I.Plant E.*

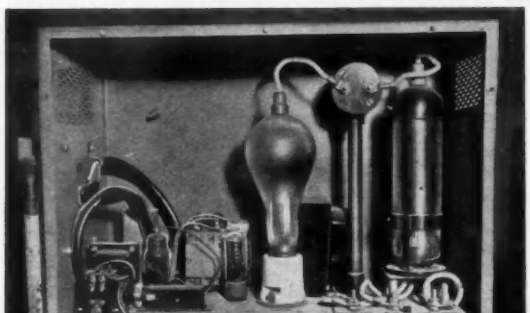
THE plastics industry is concerned with the conversion of basic chemicals into plastic materials, which are then converted, either direct or through intermediates, to "end products." The production of plastic materials involves chemical processes and the use of chemical plant, while the production of intermediates and end products employs mainly mechanical operations. A brief description of the processes employed in the production of plastics is necessary before considering the present and potential uses of electronics in the plastics industry.

Plastics can be divided into two main groups, namely, thermoplastics, such as polyvinyl chloride and polyethylene; and thermosetting materials, such as those derived from phenol, urea and melamine resins. The thermoplastics soften to a greater or lesser extent with a rise in temperature, while the thermosetting materials, in the form in which they occur in the end product, do not soften with a temperature rise and are not readily combustible.

The basic process in the manufacture of thermoplastic materials is that of polymerisation, in which the basic chemicals, with the addition of a catalyst, are subjected to closely controlled conditions of pressure and temperature. These processes are carried out either as continuous or batch operations, according to the particular production technique used. These operations involve the handling and storage of the chemicals in solid, liquid or gaseous form, and the process of measuring, reacting, drying, screening, grinding, blending and finally packing the resultant product.

The production of thermosetting resins involves similar processes, but is usually carried out as a batch operation. These resins are then usually subjected to further processes, according to the particular intermediate product for which the resin is intended. Among the intermediate and end products are moulding materials, paint, varnishes, industrial and decorative laminated sheet.

Control unit for Heenan & Froude dynamatic-controlled slip coupling



Moulding powders are produced by crushing the resultant resin obtained from the reaction process, blending, mixing with dyes and filler, rolling under controlled time and heating conditions, crushing, grinding, sieving, blending and finally packing. Varnishes are produced from synthetic resins by mixing with drying oils, heating, thinning with solvents, and filtering to a clear state. Industrial and decorative laminated products are made with resin-impregnated papers or cloths, cut to size or shape, and treated in hydraulic presses under controlled heat and pressure conditions.

The fabrication of finished products is carried out in many ways according to the plastics used and the particular product. Mouldings are produced in presses or by injection moulding, while other forms are produced by extrusion. Plastic sheet is manufactured on calenders, and rigid or semi-rigid sheet on presses.

In all these processes, pressure, temperature, time and measurement and control of quantities within close limits are extremely important, and careful regard for all these factors is essential for the making of a uniform product. Temperature control is of extreme importance in the manufacture of thermosetting resins, and with some reaction processes high pressures can develop, which require careful control.

Electronic equipment can be used with advantages in all phases of production, providing it is available in a suitable form to meet any special hazards or safety features of the particular phase. Its accuracy and quickness of response would be ideal for the control of temperature, pressure and quantity, which are very critical factors in practically all the processes.

Unfortunately, in the initial stages, many of the raw materials used are of an explosive or inflammable character, and some also create problems of corrosion and chemical reaction with certain metals. This means the extensive use of flameproof equipment for the electrical installation and, in certain cases, non-corrosive or chemically-inert materials must be used.

Other raw materials come into Group IV category of inflammable gases and vapours, as listed in B.S.S. 229. This fact raises further complications, since these materials are outside the range for which approved enclosures of

* Bakelite, Ltd.

electrical apparatus are at present available. When the plastic is in a powder form there may still be a need for flameproof equipment. The prime need, however, is for dust-tight apparatus, as the majority of resin dusts can create an explosion hazard under certain conditions.

Established Applications

In view of the difficulties arising from the use of electrical equipment, as mentioned above, and as the safety of plant and personnel must always receive primary consideration, the use of electronic equipment has been rather slow and restricted in the plastics industry. Electronic equipment has, however, been used with success and advantage for certain applications, brief mention of which is made in the following paragraphs.

Low-voltage electrode systems are being used for the control and indication of liquid levels in storage vessels where they act as a control over feed pumps and give audible indication when the level drops below a set range. They are also used in a similar manner to control the rate of feed into and out of powdered resin feed hoppers in production lines.

In addition to the usual applications, such as smoke density measurement and machine guarding, photocells are also employed to control the quantity and stacking on paper cutting machines and as tracking controls for the winding-up side of paper impregnators, in which two photocell units are positioned at the paper edge, one being normally covered and the other clear. Any change in this state operates a reversing motor control contactor to give the desired change in direction to the winding mandrel.

Thickness gauges of the beta-ray type are used in the measurement of varnish impregnation on paper impregnators and the thickness of calendered polyvinyl chloride sheet. Attempts have been made to use similar gauges for the measurement of metal wear and erosion on the shells of pressure vessels, but in some cases these are not wholly successful due to the build-up of scale and uneven surface pitting.

In hydraulic presses where pressures of the order of 4,500 p.s.i. are common, distortion of the press through mechanical failure or incorrect loading of the daylights could create a hazard. Strain gauges fitted at critical points on the structure and working in conjunction with electronic equipment give indication of the extent of deflection and can close down the plant under critical conditions.

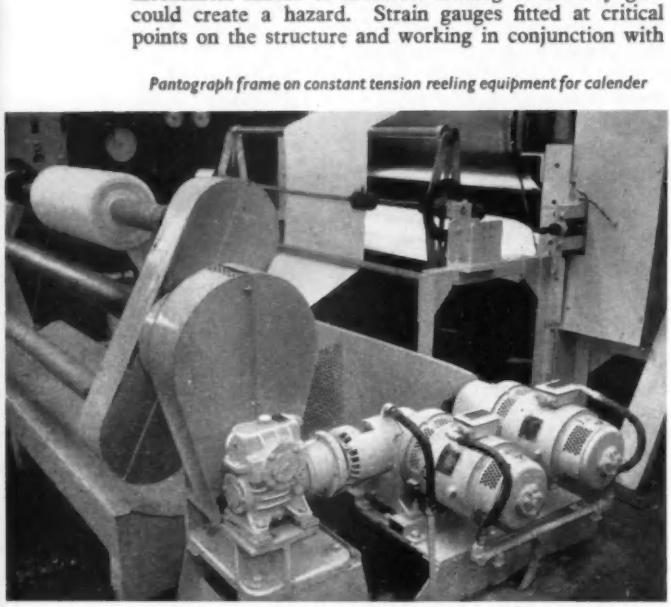
Instruments embodying electronic equipment are also applied with advantage in multi-point measurement and control of heating processes or extruders where the heating medium is electrical rather than steam or hot water. These latter methods have their own difficulties, which are discussed in a later paragraph.

High-frequency heater cabinets are used extensively for pre-heating materials prior to final forming in presses, giving a much better and uniform product and considerably improving throughput.

For remote indication of weighed batches of material, successful methods using Selsyn units are employed. Master Selsyn units coupled to the weighing equipment are wired in parallel to follower units installed at the central control station, and marked with the appropriate scales. An extension of this system is used to control rotary valves in the supply lines.

Electronic detectors are used to reveal foreign metal in certain stages of production where the plastic is in powder, pellet or strip form. Apart from the effect of such metal on the quality of the product, extensive damage could be done to rolls or calenders, with subsequent loss of production. Therefore, additional controls are linked with the detector to mark off the contaminated area, set off audible and visual signals, and also shut down the conveyor and preceding feed lines.

Pantograph frame on constant tension reeling equipment for calender

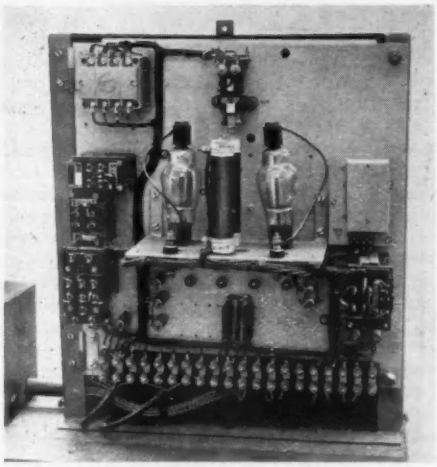


Variable-Speed Drives

In the intermediate stage of manufacture, extensive use is made of electronic controls working in conjunction with variable-speed drives on calenders, rolls and extruders, or as a medium for providing a variable-speed drive, such as the dynamatic-controlled slip coupling.

Calenders working on thermoplastic materials are usually driven by large horse-power variable-speed motors in order to give the maximum economic output compatible with the material and thickness of sheet. Because the sheet leaves the calender in a hot and plastic state, and solidifies as it cools along the run, it is necessary, in order to avoid distortion and variation in thickness, to apply constant tension across the width of the sheet at the wind-up end. The wind-up drive must also cater for the speed range of the calender drive and the build-up of material on the winding mandrel. This latter requirement necessitates a reduction in radial speed as the diameter increases, to maintain constant linear speed. A successful method of achieving this result is by means of a thyratron speed control equipment operating on a closed loop system to control the wind-up drive. Briefly, the system is as follows:—

A d.c. wind-up motor with a constant voltage field supply from a metal rectifier has its armature fed from a pair of grid-controlled rectifiers. Pre-set speed to match up with the calender speed is obtained by adjustment of a speed control potentiometer in the grid voltage circuit, and speed adjustment to take care of mandrel build-up and to maintain constant tension is controlled by transductors fitted to a swinging pantograph frame through which the plastic sheet runs. The transductor is mounted on the central spindle of this frame and the sheet is threaded through to run over free rollers at the top and bottom of the frame and then on to the wind-up mandrel. Predetermined applied tension can be adjusted by the alteration of weights on a lever attached to the frame. Under stable conditions the frame is maintained in a vertical position as the weights balance against the tension in the sheet which is running freely on to the mandrel.



Control unit for constant tension reeling equipment

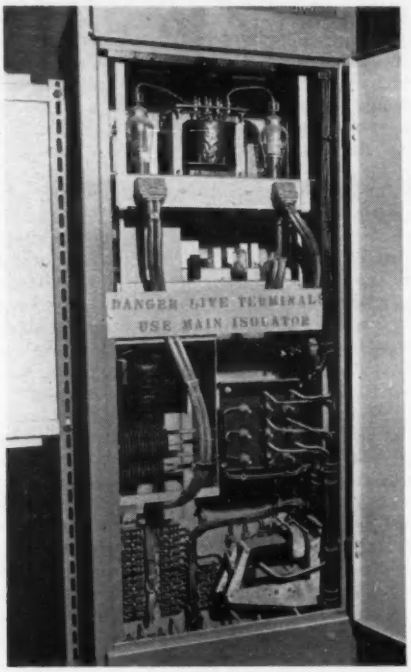
With an increase in tension, the frame swings in the direction of the pull, thus altering the position of the transductor rotor, and creates a potential difference between the control and reference voltages in the rectifier grid. This voltage difference is used to adjust the armature supply to slow down the wind-up motor until a state of equilibrium is reached. With a loss of tension, the frame swings in the reverse direction which, in turn, speeds up the wind-up motor to readjust the tension. A similar control system, but without the pantograph, is used for applying excess tension to calendered sheet in order to stretch the material into film thickness of stable dimensions.

Future Applications

The future application of electronics to the plastics industry is likely to be more extensive, especially in the light of recent developments. There are complementary developments in electronics and plastics, such as printed circuits, using copper-faced laminated sheet and encased or potted components, which lead to greater simplicity and reliability in circuit design. The development of transistors and semi-conductors will tend to eliminate the thermionic valve, which was always treated with a certain amount of suspicion by the more conservative plant engineers.

The greatest development is likely to be in the instrument field, with particular reference to the control of process functions, such as quantity, time, heat and pressure. This will lead to more automatic control of the processes which, in turn, will mean electronic control on the main plant machinery to give a corresponding accuracy and speed of response to match the instruments.

It is the modern practice for chemical plants with explosive or inflammable hazards to be housed in widely-spaced open or light structures, with a central instrument station or control room housed in a more enclosed building some little distance away. Primary elements are often situated about the plant, with or without local indication, and with the connections carried through to indicating, recording and control instruments in the instrument station. Independent means of control are possible for the sections of the process for which it is impossible or undesirable to have automatic instrument control. It will be appreciated that this arrangement would lend itself readily to electronic automatic control



Control cabinet for plastic film stretching equipment

of the process if the necessary equipment were available to suit all requirements, and if the economics and advantages gained outweighed those of the existing systems sufficiently to justify such a development.

In view of the hazards present in such a plant, it will be necessary for all electronic instruments, the associated primary elements, interconnecting wiring and the electrical actuator on the controlled medium either to be flame-proofed to the required classification, intrinsically safe, housed in a non-hazardous area or treated by purging. If all the equipment is not available in one form there must be a combination of all these requirements.

Heating Control

In certain processes there is a need to apply large quantities of heat in a very short time, followed by an equally rapid cooling cycle, while keeping the process within critical temperature limits. Where the heating agent used is medium-pressure steam, or high-pressure hot water, and the cooling medium cold water, or recirculated hot water through a heat exchanger, this means the rapid action and careful modulation of large 8in or 10in valves.

To do this by a completely electronic system, entails the use of an electrical actuator on the valves. Such actuators are not readily available, or their cost is prohibitive, as compared with air-operated diaphragm valves. It is possible to have a control system combining both pneumatic and electric elements by the use of pneumatic-electric convertors, but there is a natural reluctance to install a mixed system unless there is some overriding consideration, such as non-availability of a particular element in an electric or pneumatic form, or prohibitive cost, which compels a mixed system to be adopted.

The alternative to the development of satisfactory electronic-controlled hot water heating systems is the development of electrical methods of heating, such as

high frequency, induction heating, infra-red or pure resistance heating for those processes now carried on with steam and hot water. Such systems would more readily lend themselves to electronic control and the problem is then mainly a matter of deciding which is the cheapest method, with due regard to the maintenance of the quality of the product.

Quality Control

The great handicap to the development of a fully automatic process is the need for frequent sampling and inspection of the product and subsequent adjustment of the process controls if any variation from the standard is detected; this is often done manually. This is a comparatively slow process, and results in a certain material loss, depending upon the interval between the discovery of a defective sample and the necessary corrective adjustment of the controls.

With the development of electronic instruments to give continuous measurement of the primary variables in the material and immediate adjustment of the controls for corrective action, there will be a resultant saving in time, material and labour, and a better and more stable product.

Work is proceeding on the development of equipment in an industrial form for the automatic chemical analysis of materials and the continuous measurement of viscosity, turbidity and density of liquids and solids in suspension. When such equipment is available, it may become possible to achieve the ultimate goal of a fully automatically-controlled chemical reaction process in which, apart from electronic instruments, computers would take a major role. A typical arrangement for such a process may then take the following form:—

Analysis elements in the raw material storage containers would register in a computer the composition of the raw materials. This information would be used to vary the quantity or rate of flow of materials into the processing equipment in conjunction with the pre-set quantities required in accordance with that particular production formula, which could also be previously registered in the computer. Another analysis element in the processing equipment continuously measuring the state of the mix would supply information to control the addition of catalysts or solvents and as a secondary variable on the heating and cooling cycles.

The heating and cooling cycles would be under the primary control of temperature and pressure recording controllers in conjunction with pre-set heating and cooling programme times. All the information supplied from these instruments could be routed through a computer to act as primary or secondary variables on the process control in accordance with a set production programme. At the conclusion of the process the finished product would be automatically discharged into appropriate storage vessels.

Infra-red analyser equipment is in use for the detection and measurement of gases, although development is still in progress for equipment suitable for general plant applications. With the successful development of such equipment it may become possible to use such apparatus for the measurement and control of certain process functions. In the initial processes, where gases are used as ingredients in a basic chemical material, analysers may be used to control the flow of gas to that material, based on the quality of the gas. In other processes where volatile gases are given off due to applied heat, analysers may be used as a control medium, either on the amount of heat applied or the rate at which the material is passing through that particular process.

In general, electronic control has been applied where it has obvious advantages over existing systems, and where it does not jeopardise the very necessary safety precautions required in certain processes. The further application will depend largely on the development of special equipment to compete with, and eventually replace, existing systems. In this competition, electronic systems have the merit of being able to use computer systems to the best advantage.

PROSPECTS FOR EXPANSION

AFTER a detailed review of conditions at home and abroad last year the Government's *Economic Survey 1959* finds that the United Kingdom economy " is undoubtedly much stronger than in previous years."

Demand and production are rising and it is considered that the economy can afford to expand more than in the past three years. " Subject to the need to maintain a strong external position, and the continuance of the recent record of price stability at home, the Government's policy is to do all it can to foster this expansion."

The Survey expects an increased demand on the country's resources this year (and hence a revival in activity) from several different sources. With higher real incomes in 1959, and with continuing easy terms for borrowing, it is reasonable to expect consumer demand to go on increasing. Capital expenditure by the Government, local authorities and nationalised industries will be about 11 per cent higher in real terms than in 1958-59. The biggest increases in the period covered are in electricity, railways and roads. The course of private investment and exports is less certain. A fall of one-tenth in investment in manufacturing industry will probably be offset by increases in distribution and other services. Exports should " rise towards the end of the year."

There is a warning that in the conditions of world demand and intensified competition, particularly in Europe, goods will be hard to sell. It will therefore " continue to be vitally important to keep export prices down." The Survey also points out that the increase in wages in 1958, though on average less than in previous years, was still greater in proportion than the rise in national production and productivity. If this condition continues the recent near stability of prices would be threatened.

The estimate for capital expenditure during 1959-60 by the Electricity Council is £310 million and this is divided as to conventional stations £115 million, nuclear stations £57 million, main transmission £34 million, distribution £95 million and nuclear fuel £9 million. During the calendar year 1959 the South of Scotland Board's programme is estimated to cost £28 million and that of the North of Scotland Board £15 million.

Instrumentation and Automation

The International Congress and Exhibition for Instrumentation and Automation, last held in 1957, will be repeated next year from 19th to 26th October, in Düsseldorf.

Women in Engineering

I.E.E. Discussion on a Manchester Committee Report

A DISCUSSION on "Women in Engineering" at an ordinary meeting of the Institution of Electrical Engineers on 2nd April was marked by the fact that almost half the speakers were women. The discussion was based on a report on the subject by a committee set up under the auspices of the Manchester College of Science and Technology to inquire into the employment of women scientists and technologists in the engineering industry in the Manchester area. The President of the Institution, Mr. S. E. Goodall, presided.

Sir Willis Jackson, opening the discussion, gave figures of first degrees and diplomas in arts, science and technology awarded by United Kingdom universities in 1957. In arts subjects, excluding Oxford and Cambridge, there were 2,949 men and 2,738 women; in science subjects, 2,989 men and 886 women; and in technology 2,265 men and nine women. In the 1958-59 session, 1,847 boys and 16 girls were following Dip.Tech.(Eng.) courses and 619 boys and 36 girls were following Dip.Tech. courses. In 1958, 2,157 boys and only four girls passed the Higher National Certificate examination. In 1959, Metropolitan-Vickers Electrical Co., Ltd., a firm not unwilling to recruit girls, had three women professional engineers, no women graduate apprentices, and thirteen women professional scientists. Sir Willis Jackson added that it was a desperate national situation when only a very small number of girl graduates in physical sciences were entering school teaching.

Miss Anne Shaw, chairman of the Manchester committee, suggested that in choosing a career, a woman should seek one which could be associated with marriage, since women had no business to occupy scarce training places unless they meant to make a contribution. The door to professional engineering, however, must always be kept open to the few women with a vocational drive who would make first-class engineers.

Suitability of Tasks

Mr. T. E. Goldup said that if a woman embarked on an engineering career she would certainly make a contribution. There were many tasks in industry suitable for the graduate type of woman student but there were limits to the type of work which could be given to a woman electrical engineer.

Miss M. M. Nobbs, president of the Women's Engineering Society, said that her Society had sent a questionnaire to about 640 firms on their willingness to train girls. Of the 160 who replied, 90 considered the work unsuitable for girls, 13 had no training schemes, six had girl graduates in their employ, 21 had student apprentices or trainees in their employ and 24 were willing to consider applications from girls. Thus 51 firms out of 640, or about 8 per cent, either employed girls or were willing to consider employing them.

Mr. H. West said that in Russia it was normal to meet women engineers in all walks of life. It was not unusual to find that the shift engineer at a power station was a charming lady of about 55 to whom 20 or 30 men reported. He suggested that a good woman engineer made a very good second to a brilliant male engineer. The latter was often lazy whereas the woman was tidy-minded, and the two together produced excellent results.

Councillor Kathleen Ollerenshaw, a member of the Manchester committee, said it was agreed that girls were capable of making a great contribution, but the question was whether more should be spent on their training when the wastage was so high. Nine out of every ten girls of sixteen years of age could expect to be married before the age of thirty.

At the most, employers could expect seven years of full-time working from such a girl, including training, assuming that she had an advanced level certificate before she began. Very few women found that full-time engineering in industry was compatible with married life. There were three snags about a career in engineering for girls. First, it was difficult to use it to earn money casually; second, few firms employed women engineers, and these were grouped in certain areas; and third, the hours and holidays were inflexible. If it were felt to be in the national interest to make use of the talent which some of these girls had in engineering, more part-time facilities must be provided.

Dr. H. L. Haslegrave said that in the educational institution with which he was connected there were over 1,000 residential students including only two girls. In five years' experience he had found that most of the girls who came to the institution did not make the grade, not because of lack of intellectual fitness but because of the inducement to other things than serious study.

Need for More Women Teachers

Miss Helen MacNair said that the scarcity of girls seeking engineering careers was a matter for the schools. Before the war the teaching of science in girls' schools had been poor. More women teachers in the pure sciences were urgently required.

Dr. K. R. Sturley said that the majority of industrial firms did not want women engineers. The universities, schools and parents must share the blame for not encouraging women to enter electrical engineering. Women were better at dull routine work than men because they were more conscientious; they were very good operators but not good maintainers; they were more trustworthy when on the job but more casual about turning up to do it; and they were less mobile. The future was bright for the woman technician but not so bright for the woman engineer.

Dr. W. J. Gibbs emphasised the problem of wastage among women, who were employed by his company as mathematicians, scientists and engineers. The average length of service of the professional women was only 2¾ years, and when they left they left the engineering profession.

Mr. Calkin said that the requirements of his firm on 1st January for graduate scientists and engineers totalled 92 and of these, 37 vacancies were declared suitable for women. The number of male scientists interviewed was 540 and the number of female scientists 43. His company was prepared to employ more women when they competed successfully with their male counterparts, but he believed that industry was primarily a man's world and that the company would continue to recruit men for vacancies unless and until women were found to do the job better or the manpower situation called for dilution.

Power Supply in Southern Rhodesia

Costs Affected by Decline in Sales to Gold Mining Industry

ONLY passing references are made in the latest report of the Southern Rhodesia Electricity Supply Commission to the Federal Power Board's Kariba hydro-electric scheme, but the forthcoming availability of power from this large project inevitably has an important bearing on the Commission's operations. It had been hoped, for instance, that the existing scale of tariffs would have enabled the Commission to balance its revenue and expenditure before a supply of low-cost power was received from Kariba. A continued decline in the requirements of the gold mining industry, however, has reduced the rate of increase in electricity sales, necessitating an upward revision of tariffs. In 1957-58 there was a net loss on the Commission's trading of £121,806, making the accumulated deficit at 30th June last £620,554.

Consumption by the gold mining industry in 1957-58 —representing some 22 per cent of the Commission's sales to all classes of consumers—decreased by 1·5 per cent to 150·5 million kWh. Nevertheless, mining supplies as a whole were 10 per cent greater than in the previous year, as shown in the accompanying table.

SOUTHERN RHODESIA ELECTRICITY SUPPLY COMMISSION: ANALYSIS OF SALES

Class of Supply	1956-57 (Million kWh)	1957-58 (Million kWh)	Per cent inc. or dec.
Mining—			
Asbestos	108·0	117·2	+ 8·5
Chrome	16·6	21·8	+ 31·0
Gold	152·8	150·5	— 1·5
Other Minerals	7·9	24·4	+207·4
Total	285·3	313·9	+ 10·0
Municipal	95·2	109·5	+ 14·9
Industrial	168·2	174·9	+ 4·0
Farming	35·4	41·6	+ 17·6
Other	35·1	37·5	+ 7·0
All Supplies	619·2	677·4	+ 9·4

The largest rate of increase recorded last year was in farming supplies, which rose by 17·6 per cent to 41·6 million kWh. Farming consumers are defined as those occupying more than 50 acres and who hold a farming licence. Their average consumption last year was 15,964 kWh. The Commission comments that while this average was high, nearly a third of the farms used less than 6,000 kWh (including, of course, those connected during the year). At the other end of the scale 434 farms used between 24,000 and 60,000 kWh while 73 took over 60,000 kWh.

In the field of generation, the main event of the year was the starting up of the final 20 MW unit in the Umniati station, thus completing the Commission's programme in view of the construction of the Kariba station. To obviate the need for further generating plant before the Kariba project is ready, a 330 kV line is being constructed linking the Bulawayo, Umniati and Salisbury stations. This will also make it unnecessary to duplicate the existing Gatooma-Norton 88 kV line.

Plant capacity at the end of June aggregated 183 MW, including 120 MW at Umniati. A total of 660·3 million kWh was generated and in addition 83·8 million kWh was purchased from Bulawayo Municipality, 26·8 million from Salisbury City Council and 25·8 million from the Sociedade Hidro-Electrica do Revue, making 796·7 million kWh generated and purchased.

Fuel statistics included in the report show that the thermal efficiency of the Commission's stations ranged from 14·21 to 23·23 per cent and averaged 20·83 per cent.

Revenue totalled £3,302,363 (against £3,031,574), production costs amounting to £3,424,169 (£3,304,828). The basis of the accounts has, however, been changed and the 1957-58 production costs include depreciation provision in excess of capital charges on the new basis to the extent of £61,246. There was a small reduction in the average price received per kWh sold, from 1·165d to 1·164d (including accrued and sundry revenue, from 1·175d to 1·170d). The average cost per kWh sold decreased from 1·281d to 1·213d.

Salisbury Expansion

Electricity supply in Salisbury, the capital, is the responsibility of the municipal undertaking, the activities of which are reviewed in the 1957-58 report just received from Mr. J. E. Mitchell, B.Sc.Tech., M.I.E.E., M.I.Mech.E. It is ten years since Mr. Mitchell was appointed city electrical engineer and in an introduction to the report he shows how phenomenal has been the growth of the undertaking in that period. There are now four times as many consumers as in 1948 (27,766 against only 7,716) and five times as much electricity was sold last year (368·3 million kWh against 72·5 million).

Unfortunately, restrictions on capital expenditure have recently limited the amount of work that can be done to meet this development. Last year the estimated requirements of £2,150,750 were cut to £1,800,000, the most serious reduction being in the distribution section where expenditure was cut from £1,170,600 to £850,000—some £100,000 less than the average for the two previous years. For the current year £915,700 has been allowed for distribution work compared with the £1,041,000 estimated expenditure required. Moreover, changes in financial procedure (credits from recovered plant may not now be applied to reducing gross expenditure) mean that the effective reduction is of the order of £200,000, or 20 per cent. This, it is stated, may make it necessary to submit a supplementary estimate later in the year.

Of the 368·3 million kWh sold last year, 341·5 million was supplied to consumers in the Council's area and 26·8 million kWh in bulk to the Commission. Sales to the various classes of consumers in the supply area were as follows (million kWh):—Domestic, 182·5 (162·1); industry, 84·2 (56·7); farms, 2·3 (2); municipal and public lighting, 34·5 (26·9); and commercial and others, 38 (33·4).

Income from the sale of electricity amounted to £2,259,000 (against £1,741,081), equivalent to 1·472d per kWh sold (1·379d), the increase in average price resulting from higher tariffs which came into force in March, 1957. With other revenue, the aggregate figure was £2,288,747 (£1,778,274). Expenditure totalled £2,218,415 (£1,696,144), leaving a surplus of £70,332 (£82,130) of which £40,000 (£42,650) was allocated to the accident insurance fund, £21,213 (£35,731) to rate fund revenue and £9,119 (£3,749) to revenue contributions to capital.

NEW ELECTRICAL EQUIPMENT

Infra-Red Grill

Cooking times varying from 30 seconds for steak to five minutes for sliced game are claimed for the new "Modeq" infra-red grill now being produced by the MODERN EQUIPMENT CO., LTD., Court Ash, Yeovil, Somerset. The grill, which is completely chromium plated, has a grilling surface measuring 7in by 10in and because of its 1,200 W element the heating-up time is only eight minutes. Models

Modern Equipment Co.'s "Modeq" infra-red grill

are available in 200/220 and 230/250 voltage ranges and each is guaranteed for twelve months. The price is £10 10s.

Batch Furnaces

The series E-HDF range of heavy-duty horizontal electric batch furnaces announced by BARLOW-WHITNEY, LTD., 2, Dorset Square, London, N.W.1, for all general heat-treatment processes, including annealing, stress relieving, vitreous enamelling, hardening and tempering operations, has two basic models, E-HDF 950 for operating temperatures up to 950 deg C and E-HDF 1100 for operating temperatures up to 1,100 deg C.

In the former furnace the heavy-gauge 80/20 nickel-chromium spiral heating elements are housed in moulded carriers and operate at normal mains voltage, while in the higher temperature models strip elements are employed fed from a step-down transformer at a reduced voltage.

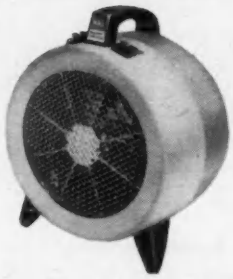
A wide choice of chamber sizes is available for both types, from 18in wide by 9in high to 48in wide by 36in high, with optional front to back depths up to 96in. Graded insulation and fully automatic electronic pyrometric temperature control ensures optimum efficiency and consistent performance. Optional features include door heating, retractable loading platform, gas curtain and, on the larger units, zone control and a power-operated door.

Automatic Voltage Regulator

An automatic voltage regulator announced by the JOHN MORRIS ELECTRICAL ENGINEERING CO., LTD., Vulcan Road, Bilston, Staffs., employs a powerful, low hysteresis spring restrained torque motor, sensitive to variations in output voltage, to operate a patented contact system. This comprises two roller contacts operating in conjunction with 96 individually spring loaded, electrically separate contacts, each of which switches its own resistor to restore the output voltage. A static rate of change feedback circuit is employed to eliminate hunting. The addition of three external components converts the unit from single to parallel operation.

Fan Heater

A new fan heater, the "Popular," has been added to the "Magicair" range of heaters produced by MAGICOOK APPLIANCES, LTD., Shirland Mews, London, W.9. It has a loading of 2 kW and heat selection (either 1 or 2 kW) or fan speeds can be controlled by switches situated at the top of the casing. The unit is constructed of steel, attractively finished in two-tone colours, and is fitted with a



Magicook Appliances "Popular" fan heater

moulded handle and feet. Apart from heating, it can also be used for airing and drying clothes, ventilating and cooling, and also as a hair dryer. The price is £6 9s plus £1 8s purchase tax.

Transposed Transformer Conductors

Continuously transposed strip conductors for transformer windings are now being manufactured by BRITISH INSULATED CALLENDER'S CABLES, LTD., 21, Bloomsbury Street, London, W.C.1. The strips are individually insulated with a polyvinyl acetal enamel, then continuously transposed in strand fashion, and finally paper insulated overall.

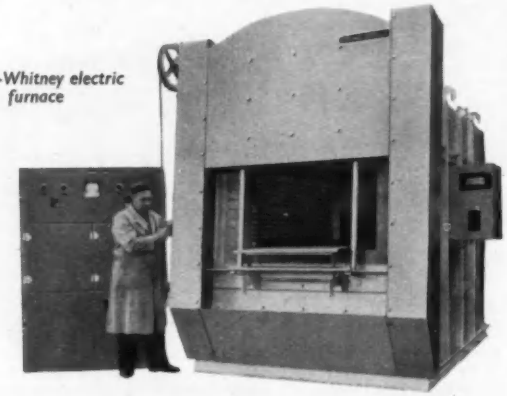
Mobile Welding Set

A single-operator wheel-mounted a.c. welding set providing a maximum intermittent welding current of 700 A at 80 V has been introduced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.

The type O.T.2 set has an output ranging from 120 to 700 A in 25 steps, with a continuous manual welding current rating of 650 A. Rated at 52 kVA, in accordance with B.S. 638

G.E.C. mobile welding set

Barlow-Whitney electric furnace



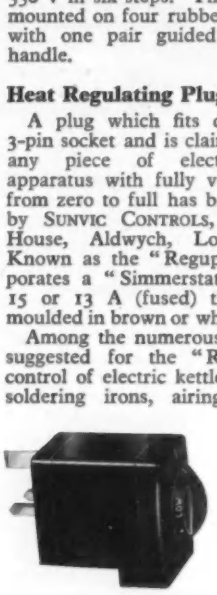
group Y, it consists of an oil-immersed single-phase transformer and separate choke enclosed in a fabricated sheet-steel tank which also can contain a 20 kVAr air-cooled capacitor in a separate compartment.

Regulating handles are provided for coarse and fine welding current control, and transformer primary tappings, brought to a terminal board beneath a small lid on the top cover, accept a supply voltage ranging from 380 to 550 V in six steps. The whole unit is mounted on four rubber-tyred wheels, with one pair guided by a towing handle.

Heat Regulating Plug

A plug which fits directly into a 3-pin socket and is claimed to provide any piece of electrical heating apparatus with fully variable control from zero to full has been introduced by SUNVIC CONTROLS, LTD., Crown House, Aldwych, London, W.C.2. Known as the "Reguplug," it incorporates a "Simmerstat" in either a 15 or 13 A (fused) three-pin plug, moulded in brown or white Bakelite.

Among the numerous possible uses suggested for the "Reguplug" are control of electric kettles, percolators, soldering irons, airing and drying



Sunvic Controls "Reguplug"

cabinets, blankets, sterilisers and any item needing variable heat control. The overall dimensions of the unit (excluding pins) are 3⅛in long by 2 1/16in wide by 2½in deep (13 A), and 2⅞in long by 2 1/16in wide by 2½in deep (15 A). The prices are £1 17s 6d (13 A) and £1 15s (15 A).

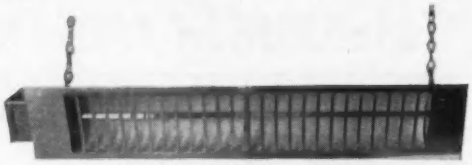
Dry Shaver

The EVER READY CO. (GREAT BRITAIN), LTD., Hercules Place, Holloway, London, N.7, has joined the field of electrically operated dry shaver manufacturers with the introduction of the "Figaro" shaver, which is available in three models.

The "Figaro I" is a de-luxe model with two interchangeable foils—one thin (0·002in) and one extra thin (0·0015in); a snap-up trimmer which retracts into the side of the shaver body when not in use; and a built-in on/off switch. It incorporates a synchronous pulsating power unit (a.c. only) claimed to be trouble free and quiet in operation and may be used on either a 100/125 V or 200/250 V supply. The price, with 2-pin plug and flexible, and b.c. adaptor, in a presentation case within which is a separate travel wrap, is £10 10s.

The "Figaro II" is as above but is packed in a "Rexine" covered steel case and the price is £8 15s including tax. The "Figaro III" has only one foil (0·002in) and is without the built-in on/off switch and dual voltage refinements. Its price, in "Rexine" covered steel case, is £7 7s including tax.

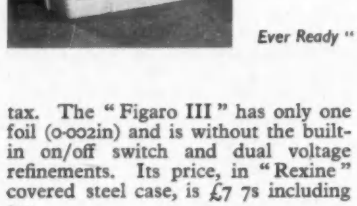
Ever Ready "Figaro I" dry shaver



Metway "Glowaway" infra-red heater

Portable Power Point

The "Herga" portable power point recently introduced by HERGA ELECTRIC HEATING SYSTEMS, 5, Northolt Road, Harrow, Middlesex, has been designed for use in the home, garage and workshop, etc., where it is often necessary to use an appliance or tool



Herga portable power point

at a greater distance from a fixed power point than that permitted by the cable of the appliance itself. It consists of a substantial anodised aluminium reel which contains 20ft of 3-core p.v.c. flexible cable, and also forms the base for the outlet socket into which an appliance may be plugged. The cable is fitted with a 3-pin plug of the same type as the socket. There are four models each 7in in diameter by 3¼in high.

Models fitted with a 15 A round pin plug and socket and 15 A capacity cable are priced at £1 17s 6d (558/15); 13 A flat pin (fused at 13 A) with 13 A cable, £1 16s (558/13); 5 A round pin with 5 A cable, £1 11s (558/5); and 13 A flat pin (fused at 5 A) with 5 A cable, £1 11s (558/135).

Infra-red Heaters

The "Glowaway" industrial range of infra-red heaters, now being marketed by METWAY ELECTRICAL INDUSTRIES, LTD., Canning Street, Brighton, 7, are available in 24, 36 and 48in sizes, with loadings of 725, 950 and 1,450 W respectively. The finish is in hammered silver and each model is supplied complete with chains and hook plates for ceiling mounting. The prices are £4 5s (DA.850), £5 19s (DA.1190) and £8 2s 6d (DA.1626).

Battery Chargers

A new range of single circuit, industrial and garage battery chargers has been introduced by LEGG (INDUSTRIES), LTD., Williamson Street, Wolverhampton, Staffs. They incorporate a high-reactance double-wound transformer, earth tested at 2,000 V a.c., and a high-voltage full-wave bridge connected selenium metal type rectifier. Transformer tapping switches are used to adjust the charging current, a special tapping method enabling coarse and fine adjustment to be made on low cell values.

There are 12 different models with outputs ranging from 5 to 15 A and with capacities of 6 to 36 cells (connected in series). Connected to a 230 V supply at 2·5 V per cell, the maximum output for the smallest model is achieved with an input current of 1·1 A and a power consumption of 205 W; with the same conditions, the largest model has a consumption of 1,170 W with an input current of 6·5 A.

All models are suitable for charging from 3 cells up to the maximum, over a current range of 20 to 100 per cent from 2 to 2·5 V per cell. Dimensions vary from 17in high by 17½in wide by 10½in deep to 23in by 25½in by 12½in and weights from 44 lb to approximately 110 lb. The prices are from £21 10s to £46 10s.

One of the new range of Legg single circuit battery chargers

GENERATION and DEVELOPMENT

Dudley Change-over Completed

Switchgear and rotary convertors which have been taken out of commission at Dudley, Worcs., may continue to have a useful life at the Atomic Energy Research Establishment at Harwell. This was stated by the chairman of the Midlands Electricity Board, Mr. W. S. Lewis, speaking at the Board's Hall Street substation on 2nd April, when the Mayor of Dudley, Alderman F. G. Lewis, switched off a 400 kW convertor, the last of a series that has been supplying d.c. since the substation was established shortly before the 1914-18 war.

The ceremony marked the completion of the change-over of Dudley consumers from d.c. to a.c. When the Board was established in 1948 about 4,200 of the 12,000 consumers then in the borough were still receiving d.c. supplies. In the following years the amount of change-over work was limited by capital restrictions and other urgent demands on labour resources, but in 1954 it was possible to launch a five-year programme that has now been completed at a total cost of £200,000.

Mr. Lewis said that in the M.E.B. area as a whole there were 74,000 d.c. consumers in 1948, and now only 250 remained in two towns—Birmingham and Leek—where it was hoped to complete the change-over during this year. Most consumers in Dudley were now served by a standard distribution system and the next task would be the provision of standard supplies for those in surrounding areas who were connected to the 200 V system.

Scottish Hydro-Electric Contracts

The North of Scotland Hydro-Electric Board has placed contracts for the main civil engineering works of its Loch Glashan scheme on Lochfyneside and for the plant for two stations of the Strathfarrar and Kilmorack scheme in Inverness-shire.

The Loch Glashan scheme will produce 17·6 million kWh annually. The works consist of a main dam at the outlet of Loch Glashan from which water will be led by tunnel and pipeline to a power station with a capacity of 6 MW on the shore of Loch Gair, a bay on Loch Fyne. William Tawse, Ltd., Aberdeen, have been given the contract to build the dam at Loch Glashan and collecting aqueducts, the tunnel, pipeline and the generating station. Reed & Mallik, Ltd., will construct a system of collecting aqueducts and other works to make use of the upper River Add and River Tunns, and James Young (Contractors), Ltd., Glasgow, will construct aqueducts and other works on the headwaters of the River Crarae. The civil engineering consultants are Messrs. Crouch & Hogg, Glasgow, and the electrical and mechanical consultants are Messrs. Strain & Robertson, Glasgow.

The Strathfarrar plant contract is for four 10 MW Kaplan turbo-generators to be installed in the Aigas and Kilmorack power stations. These two stations, which will each have a capacity of 20 MW, will be situated on the River Beauly. The alternators will be manufactured by Bruce Peebles & Co., Ltd., Edinburgh, and the turbines, which will be of Boving design, will be made under sub-contract in the west of Scotland. The electrical and mechanical consultants are Messrs. Kennedy & Donkin.

Better Lighting for Underground Stations

London Transport is to improve the lighting of 14 of its Underground stations this year. Work is already in progress at Tottenham Court Road, where 340 80 W 5ft tubes are being installed along the four platforms, above the escalators, and in the subways and booking hall. The work should be completed by mid-summer, and a start will then be made on the installation of fluorescent lighting at Holborn; this should be finished by the end of the year.

At five East London Line stations —Whitechapel, Shadwell, Wapping, Rotherhithe, and Surrey Docks— where electricity for lighting is taken from the 600 V d.c. traction supply and the lamps are connected in groups in series, new feeder cables, lighting circuits and additional fittings are being installed and the lighting system will be fed from the standard a.c. supply when this work is completed. Emergency lighting is also being added.

At seven other stations, extra lighting points are being installed to improve the general level of lighting. These stations are Kentish Town, Tufnell Park, Sudbury Hill, Sudbury Town, North Ealing and Neasden. Similar work will be undertaken later at Arsenal station.

Road Heating in Edinburgh

At a cost of about £1/sq ft The Mound, one of Edinburgh's steepest streets, is to be kept free of ice by warming the surface with buried electric cables. The heating system, with a total loading of 760 kW, will be switched on automatically when the air temperature and humidity are likely to cause frost. The works committee of Edinburgh Corporation on 26th March approved a tender by William Allan Smith & Co., Ltd., for the laying of the cable at a cost of £4,556. The control equipment will cost £1,000 more. Half the cost will be borne by Government grant. The city engineer, Mr. W. P. Haldane, said experiments had shown that the surface could be kept dry when there was 12 degrees of frost. The running costs of the system were difficult to estimate, but against them had to be reckoned the £250 a year it cost to spread grit on The Mound.

"Manweb" Achievements in 1958-59

An additional 18,000 consumers were connected to the Merseyside and North Wales Electricity Board's mains during the year ended 31st March last and electricity sales rose by over 6 per cent to 5,000 million kWh. Despite financial restrictions during more than half the year, the Board was able to extend its mains to 1,400 farms (200 more than the target) and 2,000 other premises in the countryside.

Helped by the removal of hire-purchase controls, appliance sales rose sharply by 20 per cent to a record total of £2,400,000. No fewer than 20,000 cookers and 18,000 water heaters were sold, increases of 3,000 and 6,000, respectively, over the previous year's figures.

More Floor Warming Installations

The South Shields and Wallsend Corporations are the first local authorities in the North-East to use under-floor electric heating for new blocks of flats. South Shields Corporation is to use the system in 243 three-storey flats at Laygate. In addition to heating, the flats will have electric water heaters, electric cookers, and electrically-heated drying cupboards. Each block of nine flats will have an electric incinerator to deal with household refuse.

Members of Wallsend Town Council have inspected blocks of all-electric flats at Kirkcaldy, Scotland, and have been impressed by the favourable comments of the tenants, all of whom favoured the system of floor heating and stated that, taking into consideration the numerous advantages offered, the cost compared favourably with the usual forms of heating by solid fuel. The dwellings to be provided with under-floor heating at Wallsend consist of 354 multi-storey flats on the Low Willington Farm estate.

Woolwich Borough Council has decided to install electric floor warming in two nine-storey blocks of flats at Eltham.

Test Run on Kent Line

An electric train travelled between Canterbury East and Selling, near Faversham, last week on a test run. Electric services between London (Victoria) and the Kent coast are planned to start in June.

Financial Section

STOCKS and SHARES

THIS year's Budget was awaited with much more than the customary degree of optimism, so that for a time the main point of interest in Stock Exchange markets will be the disclosure of the extent to which the Chancellor's proposals are considered to substantiate the strong rise in share prices which preceded it. When this process of adjustment has run its course, no doubt the matter of the General Election will come further to the fore as the main factor in the investment prospect. Meanwhile the flow of company results and dividend declarations on account of 1958 continues to provide plenty of local incident. In the electrical markets, this week's announcements from A. Reyrolle and British Insulated Callender's Cables were awaited with particular interest.

Bruce Peebles Issue

The shares of Bruce Peebles & Co. are officially quoted now in London as well as in Edinburgh. Capital changes recently approved are also thought likely to make for freer dealings in the shares, by reducing the price from the formerly heavy figure of over £7 per £1 share. The company is now trebling the issued ordinary capital by the distribution of a two-for-one scrip issue from the substantial reserves, and is also splitting the denomination of the shares into units of 10s. In the new form dealings began this week at a price of about 26s, with the new shares a few pence higher. Dividends of 30 per cent have been paid for each of the past two years. An equivalent distribution on the present capital of a little over a million would produce a yield of a fraction under 4 per cent on the 10s units at their present price.

Trading Outlook

For the past year Bruce Peebles returned profits at a level lower than the previous figure, but the report pointed out that the comparison between the results of one year and another could be misleading because of the increasing size or duration of the contracts on which the company is engaged. The net profit of £184,000, after tax, still provided almost threefold cover for the amount of the ordinary distribution. Further prospects were said to be closely linked with Government policy, in which connection the chairman's review noted the measures taken recently towards the expansion of capital investment and, in general, a slightly better atmosphere since the beginning of the current year. At the annual meeting the order book was said to have a much healthier appearance than was the case three months ago. Recent new orders worth over a million were mentioned.

Taylor Tunnicliff

Shareholders of Taylor Tunnicliff (Electrical Industries) were told at the annual meeting that the various businesses in the group had made a fairly promising start to the current year, and the chairman felt confident that the company was well established and equipped to maintain a leading position in the industry. The 5s

Price Changes in

Company or Board	Nom. Value	Middle price 6th April	Three Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1959 Highest	1959 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	79	+½	3	3	3 16 0	80½	77½
Brit. Elec. 1974/77	100	75½		3	3	3 19 6	77	74½
Brit. Elec. 1976/79	100	80½	+½	3½	3½	4 7 0	80½	77½
Brit. Elec. 1974/79	100	89	+1	4½	4½	4 15 6	90½	87½
Overseas Electric Supply								
Calcutta Elec.	£1	17/6	+6d	6·8†	7†	13 18 0	17/3	16/-
East African Power	£1	20/3	−9d	7½	8	7 18 0	22/3	19/3
Nigerian Elec.	£1	14/6	−6d	10	10	13 16 0	15/-	13/9
Perak Hydro-Elec.	£1	14/6		12½	10	13 16 0	14/6	12/3
Electrical Shares								
Aberdare Holdings	5/-	16/-x.d.		17½	17½	5 9 6	16/3	15/6
Aerialite	1/-	9/6	+6d	51½	54	5 14 0	9/6	7/9
Allen, W. H.	£1	45/-		10	11	4 17 9	45/-	43/-
Anglo-Portuguese Tel.	£1	28/3		8	9	6 7 6	29/3	26/6
Aron Elec. Ord.	£1	57/6		15	15	5 4 3	61/6	57/6
Assoc. Elec. Ord.	£1	57/6	+2/6	15	15	5 4 3	59/-	53/9
Automatic Tel. & El.	£1	77/6	−1/-	17	17	4 7 9	82/-	77/6
Babcock & Wilcox	£1	52/6	+2/6	15	13‡	4 19 0	52/6	45/6
Bakelite	10/-	26/3		15	15	5 14 3	26/9	22/-
Baldwin, H. J.	2/-	3/-	+3d	20	20	—	3/-	2/3
Berry's Electric	5/-	15/9	+3/-	10	10	3 3 6	15/9	10/9
Bowthorpe Holdings	2/-	14/-	+1/6	37½	25*	3 11 6	14/-	11/9
British Elec. Traction: Def. Ord. "A"	5/-	35/6	−6d	25	25	3 10 6	40/-	35/6
B.I. Callender's	£1	49/-	+1/9	12½	12½	5 2 0	52/-	44/9
B.I. Callender's 6% Pref.	£1	20/-		6	6	6 0 0	20/6	19/9
British Thermostat	5/-	39/-	+3d	25	30	3 17 0	40/-	37/-
British Vac. Cleaner	5/-	7/3	+3d	10	7½*	5 3 6	7/9	4/6
Brook Motors	10/-	53/9		25	24½*	4 10 0	53/9	46/-
Bulgin, A. F.	1/-	9/3	+1/3	45	50	5 8 0	9/3	6/9
Bulpitts	5/-	12/6	+6d	—	15	6 0 0	12/6	10/-
Burco Dean	5/-	13/-	+6d	22½	16*	6 3 0	13/3	12/3
Cable & Wireless: Ord.	5/-	13/9	+6d	10	10*	3 12 9	14/-	12/3
4% Loan	100	94½		4	4	4 4 9	95	93
Chloride El. Storage "A"	£1	73/9	+1/9	17½	17½	4 15 0	73/9	65/6
Clarke Chapman	£1	61/3		27½	13¾*	4 9 9	66/3	60/-
Cole, E. K.	5/-	18/6	−3d	17½	17½	4 14 6	21/3	17/3
Contactor Switchgear	5/-	12/6		20	14*	5 12 0	13/-	12/-
Cossor, A. C.	5/-	7/6		2½	Nil	Nil	7/9	6/3
Crabtree	10/-	30/-	+1/-	20	20	6 13 3	31/6	28/-
Crompton Parkinson	5/-	13/3	+6d	16	12*	4 10 6	13/9	11/9
Davis & Timmins	5/-	14/-	−6d	22½	18	6 8 6	15/3	14/6
De La Rue	10/-	34/-	+2/3	35	17½*	5 3 6	34/-	30/3
Decca "A"	4/-	35/9	−6d	43½	50	5 12 0	40/3	34/3
Desoutter	5/-	23/3	+9d	32½	21¾*‡	4 13 3	23/3	19/-
Dewhurst	2/-	8/-	+6d	20	20	5 0 0	8/3	7/3
Dictograph Tel.	2/-	7/9	+3d	20	20	5 3 3	7/9	7/-
Dubilier Condenser	1/-	3/9		30	20*	5 6 9	4/-	3/3
Duport	5/-	10/6		25	12½*	5 19 0	10/9	10/3
E.M.I.	10/-	58/-	−1/6	15	20*‡	3 9 0	64/6	50/-
Electrical Apparatus	5/-	13/6	+3d	12½	14½	5 2 6	14/-	13/-
Electrical Components	5/-	11/6		12½	12½	5 8 9	11/9	10/6
Elec. Construction	£1	30/-		8½	8½	5 13 3	30/3	27/9
Elliott-Automation	5/-	19/9	+3/6	—	10‡	2 10 9	20/9	16/9
Enfield Cable Ord.	£1	19/6	+6d	Nil	2½	2 11 3	22/3	16/3
English Electric	£1	65/-		14	14	4 6 3	65/6	56/9
English Electric 3½% Pref.	£1	12/6		3½	3½	6 0 0	12/9	12/3
Ericsson Tel.	5/-	23/3x.d.	−1/-	12†	13†	4 17 6	27/3	25/9
Ever Ready	5/-	26/6	+3d	37½	20*	3 15 6	26/6	22/-
Falk Stadelmann	£1	26/3x.c.		17½	10*‡	7 12 6	32/9	26/3

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

shares were quoted subsequently at about 23s 3d, which is some 5s above the price ruling before the publication last month of the 1958 results. These revealed an expansion of about 18 per cent in the net taxed profit, giving more than threefold cover for the maintained ordinary dividend of 17½ per cent. The balance sheet showed reserves of £823,000 against the issued ordinary capital of £600,000; and net current assets (the working capital of the group) at the impressive total of over £1·3 million. No further details were given at the meeting regarding the merger of the company with Bullers, Ltd. The yield on the shares is 3¾ per cent.

Electrical Investments

Company or Board	Nom. Value	Middle price 6th April	Three Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1959 Highest	1959 Lowest
Electrical Shares—continued						£ s d		
G.E.C.	£1	35/-	+3/9	12½	10	5 14 3	40/3	31/3
G.E.C. 6½% Pref.	£1	21/-		6½	6½	6 3 9	21/6	20/3
General Cables	5/-	8/9		24	15	8 11 6	9/-	7/6
Greenwood & Batley	£1	79/6		17½	20	5 0 9	83/9	75/-
Hackbridge Holdings	5/-	14/9	−3d	20	20	6 15 6	15/6	14/6
Hackbridge & Hewittic	5/-	14/6	−6d	20	20	6 18 0	15/9	13/9
Head Wrightson	5/-	28/6	+2/6	22½	17½*	3 1 6	28/6	24/3
Heatrae	2/-	9/-		15	20	4 9 0	9/-	7/6
Holophane	5/-	15/6	−3d	37½	22½*	7 5 3	16/6	15/6
Hoover	5/-	63/-	+4/6	50	60	4 15 3	65/3	55/-
I.C.I.	£1	34/9		12	8*	4 12 0	38/3	33/-
Intl. Combustion	5/-	35/6	+1/9	25	30‡	4 4 6	35/6	29/9
Intl. Computers & T.	£1	65/-	−1/3	—	8‡	2 9 3	70/3	57/6
Johnson & Phillips	£1	24/3	−9d	10	5	4 2 6	30/6	22/-
Lancashire Dynamo	£1	51/6	+4/-	11	11	4 5 3	48/3	42/-
Laurence Scott	5/-	17/3		15	15	4 7 0	17/6	16/6
Lister, R. A.	£1	38/6	−6d	10	12½	6 9 9	41/-	32/9
Lucas, J.	£1	46/6	+3d	7½	10‡	4 6 0	46/6	43/3
Marconi Marine	£1	39/6		10	10	5 1 3	48/6	40/6
Marryat & Scott	2/-	9/3	+3d	35	37½	4 1 0*	9/3	8/6
Mather & Platt	£1	42/-		15	10‡*	5 1 6	51/6	41/3
Metal Industries	£1	45/6	+2/-	9	14	6 2 9	46/-	39/9
Midland Elec. Mfg.	£1	44/3		12½	10*	4 10 6	44/3	41/6
Morphy-Richards	4/-	22/6	+1/3	20	20	3 11 0	22/6	18/-
Murex	£1	49/6	+6d	20	17½	7 1 6	49/6	42/-
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/3
Oldham & Son	1/-	2/6		17½	17½	7 0 0	2/9	2/6
Parsons, C. A.	£1	51/3		8½	7½*	2 18 6	55/9	47/3
Philips' Lamps	Fl.10	109/6	+9/6	14	14	2 8 3	109/6	88/-
Plessey	10/-	73/9	+1/3	30	30	4 1 3	75/-	70/6
Pye	5/-	14/9	−9d	12½	12½	4 4 9	16/9	13/9
Pyrotenax	5/-	37/-	+9d	—	27½‡	3 14 3	38/3	33/9
Reliance Clifton	5/-	17/9		13½	15	4 4 6	19/9	17/6
Reyrolle	£1	95/-		17½	17½	3 13 9	98/-	86/6
Rheostatic	4/-	8/9		12½	12½	5 14 3	9/3	8/3
Richardsons Westgarth	10/-	15/3		16½	8½*	5 11 0	15/3	13/9
Scottish Cables	4/-	13/9	−6d	27½	27½	4 13 0*	16/3	13/3
Simon-Carves	5/-	32/-	+1/3	20	25	3 18 3	32/-	28/6
Smith (England), S.	4/-	12/9	+3d	20	12½*‡	3 18 6	12/9	11/6
Southern Areas	£1	11/-		7½	Nil	Nil	14/9	11/-
Strand Elec.	5/-	8/9		15	15	8 11 6	9/-	8/6
Sturtevant	5/-	17/6	−1/-	15†	15†	7 9 9	19/-	17/-
Sun Elec.	£1	73/-		25	25	6 17 0	73/-	66/-
Switchgear & Cowans	5/-	12/6	+9d	22½	15*	6 0 0	13/-	10/3
Taylor Tunnicliff	5/-	23/3	+9d	17½	17½	3 15 3	26/-	18/-
T.C.C.	10/-	41/-		25	25	6 2 0	41/-	38/-
Telephone Mfg.	5/-	5/3		10	10	9 10 6	5/3	4/9
Telephone Rentals	5/-	13/-		12½	12½‡*	4 16 3	13/3	11/9
Thompson (John)	5/-	25/-	+6d	25	25	5 0 0	25/-	22/9
Thorn Elec.	5/-	35/-	+6d	17½	17½	2 10 0	38/6	26/3
Thornycroft	£1	22/6	+1/3	12½	7½	6 13 3	23/-	20/6
Tube Investments	£1	82/6	+2/6	15	17½	4 4 9	85/3	71/6
Vactric	5/-	37/6	−1/3	25	25	3 6 9	44/6	26/3
Verity's	5/-	2/6		12½	2½	—	5/-	1/3
Walsall Conduits	4/-	18/3		20	22½	4 18 9	18/6	16/9
Ward & Goldstone	5/-	39/-	+2/-	40	25*	3 4 0	39/-	30/6
Watford	2/-	8/-	+3d	25	25*	6 5 0	8/3	7/6
Westinghouse	£1	42/6	−1/3	10	10	4 14 3	47/-	39/6
West, Allen	5/-	13/9	+3d	15	12½*	4 5 0‡	13/9	11/9
Wolf Electric	5/-	8/3		10	10	6 1 3	8/6	8/-

Recent Dividends

Watford Electric 2s shares have been marked up to 8s since the declaration of the final distributions for 1958, which make a total of 25 per cent, including 10 per cent bonus. This is the same as for the previous year but applies to capital increased by 25 per cent as a result of a scrip issue and represents, therefore, a 5 per cent improvement in the rate. With the net profit higher by about 20 per cent, the major portion of the distributable surplus remains to be put back into the business. The yield on the shares goes up to 6¼ per cent. Murphy Radio are maintaining the dividend at 20 per cent for the fifth year in succession although the group net profit for 1958 is down from £267,000 to £208,000 and the cover for the dividend is narrowed to rather less than twice. The 5s shares were lowered from 19s to 17s 6d as an initial reaction to the announcements and now show a yield of 5¼ per cent.

M.E.M. Report

Trading profits of Midland Electric Manufacturing in 1958 did not quite equal the record figures of the previous year, but the difference was restricted to minor proportions despite difficulties in export markets, particularly in India, and a generally lower level of industrial activity at home. A dividend of 10 per cent has been paid on capital increased by a scrip issue. This represented an increase on the previous payment, but left the better part of two-thirds of the net profit to be added back to the reserves.

Company Meetings

At the Hoover annual meeting, shareholders were advised that sales reached a very high peak after the lifting of the hire-purchase restrictions last October and had tended to level off in the first quarter of the current year. Turnover in the latter period showed a rise of no less than 77 per cent on the figures for the corresponding weeks of 1958, but there was no strict comparison between the two periods since in the early part of last year the severe credit restrictions, and a 60 per cent rate of purchase tax, were in operation. In the company's report it was said that increasing expenditure on merchandising was necessary if the group were to maintain its position in the face of very keen competition at home and overseas. At 63s the £1 shares yield 4¾ per cent. The chairman of the A. H. Hunt (Capacitors) Company, which reported higher profits and an increase in the dividend to 15 per cent for 1958, described the state of the order book as very encouraging at the annual meeting. At 11s 6d the 4s ordinary shares yield 5¼ per cent on the basis of a dividend covered three times over.

REPORTS and DIVIDENDS

Ericsson Telephones, Ltd.—In the course of his speech at the annual meeting held on 3rd April, Sir Harold A. Wernher (chairman) said that at last year's meeting he indicated that there were signs of recession in world trade which would react upon export prices. This proved to be the case, and in the circumstances the report for the year under review was by no means unsatisfactory. Operating costs were increased by the wage award granted in the engineering industry during the year. The extensive modernisation carried out at the main factory during the past few years had proved a great help in meeting the strains imposed by the recession. Their expenditure on new plant and buildings in the years 1956 to 1958 exceeded £2¼ million, financed entirely from their own resources. Invoiced sales during the year were a record, being up by 2 per cent, but rising costs and competition lowered profit margins. He expected these conditions to continue during most of the present year, but the potential need for telecommunication equipment was world-wide and it was only a question of time for this to materialise. The British Post Office had been compelled to curtail its programme of capital expenditure which had resulted in the cancellation or postponement of some contracts already placed and restraint in the placing of new ones. This had intensified competition in the remaining markets and resulted in many cases in unremunerative prices. Mr. Wernher referred to various research developments.

Hoover, Ltd.—The annual meeting was held on 1st April, Mr. H. W. Hoover presiding. A report of the company's activities in 1958 was published in our issue of 13th March. At the meeting Mr. S. Roberts, managing director, said that the total turnover for the first quarter of the current year was up by 77 per cent on the corresponding period of last year. This was hardly a realistic comparison, however, as during the same period last year they were faced with severe credit restrictions and purchase tax at 60 per cent. After the lifting of hire-purchase restrictions in October, sales reached a very high peak, which had levelled off somewhat during the first quarter of the current year, although still continuing at a satisfactory rate.

Hilger & Watts, Ltd.—The annual meeting was held on 31st March, Mr. G. A. Whipple (chairman and managing director) presiding. In his review of the past year, which had been previously circulated, the chairman said that the turnover for the year was again a record. Last year they suffered from the American recession and more recently from the reduction in defence contract work and the fall in the volume of industrial and local government expenditure. This had had an adverse effect on the sales of certain groups of instruments, but their policy of developing products over a wide field had enabled them to maintain the overall level of their incoming orders. That half of their products were exported to territories which were widely spread geographically was an important contributory factor; though the incoming order rate was not increasing they had continued a steady expansion of production, thereby reducing delivery times and in some instances building up limited stocks of instruments ready for sale. Mr. Whipple dealt with some of the more important developments during the year and briefly referred to the company's activities overseas.

Mather & Platt, Ltd., held their annual meeting on 26th March, Mr. L. E. Mather (chairman) presiding. In his circulated statement, the chairman said that all departments experienced some degree of difficulty during the year under review and even the results of the overseas subsidiary companies, when consolidated, had been clouded by the effect of the depreciation of two of the currencies concerned. Increased costs of production which could not be recovered by increased prices had had a marked effect on the year's results. Over the last few years the sale of machinery for processing textile goods had provided a diminishing proportion of the total turnover. The departments responsible for electrical and pumping plant, fire engineering products, food processing and general machinery now took up the greater part of their productive capacity. Orders for the home market had been well spread over these departments.

A. H. Hunt (Capacitors), Ltd.—The report and accounts for 1958 now issued confirm the figures given in the preliminary statement published in our last issue. In his review of the year which accompanies the report and accounts, Mr. S. H. Brewell (chairman and managing director) says that the year proved to be a successful and progressive one. Keen competition was encountered in all markets, but was met by greater efficiency, in part resulting from a long-term mechanisation programme. All sections of the business contributed their fair share to this progress. The export position was well maintained and this, together with their overseas licensee set-up, appears to indicate further opportunities for the future. With regard to home activities, production at the Wrexham factory was further extended and plans are in process of being approved to erect additional buildings which will provide increased production facilities. The new Addington unit is also being extended and a new wing now being erected should be in production within the next few months. Regarding prospects for 1959, the order book to date is encouraging.

Superheater Co., Ltd.—The trading balance for 1958 amounts to £823,378, as compared with £645,651 for 1957, to which is added other income of £27,536. Taxation absorbs £442,172, and the net profit is £408,742 (against £346,438). Revenue reserve receives £263,050 and capital reserve £19,081. The final dividend, which includes a bonus of 1¼ per cent, is 19⅛ per cent, making 25 per cent for the year (against 42½ per cent), on doubled capital. The balance carried forward is £111,488 (against £128,500 brought in).

G. & J. Weir Holdings, Ltd.—The group net profit for 1958 is £1,162,263, as compared with £1,028,131 for the preceding year. This is struck after deducting £515,446 for depreciation and £1,311,330 for taxation. It is proposed to pay a final dividend of 13 per cent (against 12½ per cent), making 17 per cent (16 per cent) for the year.

Camp Bird, Ltd., has acquired 360,000 ordinary shares of 2s each fully paid in H. J. Baldwin & Co., Ltd., from a group of shareholders in exchange for 100,000 Camp Bird shares of 10s each fully paid. The new Camp Bird shares will not qualify for the recently declared interim dividend of 10 per cent. The new shares have been granted a quotation on the Stock Exchange, London. Camp Bird, Ltd., has sold the 360,000 ordinary shares in H. J. Baldwin & Co. to its subsidiary, Hartley Baird, Ltd., thereby making H. J. Baldwin & Co. a subsidiary company of Hartley Baird, Ltd.

Veritys, Ltd.—Mr. R. M. Mair, chairman of Veritys, Ltd., announces that, acting on behalf of shareholders, he has made an approach to the liquidator putting forward proposals to enable the company to continue in business and operate from Stirchley, Birmingham.

Relay Exchanges, Ltd.—The audited accounts for 1958, a summary of which has now been issued, show a slight improvement on those given in the unaudited statement published in our 6th March issue, and the net profit for the year is now shown as £391,276 instead of £381,894 given in the preliminary statement.

New Companies

P. Lyon, Ltd.—Registered 12th March. Capital £5,000. To acquire the business of radio, television and electrical engineers carried on by the legal personal representatives of A. Lyon, deceased, at Soham as P. Lyon, etc. Directors: J. P. Clark and C. C. L. Randall. Regd. office: 56, High Street, Soham.

Richens, Ltd.—Registered 12th March. Capital £100. Designers, manufacturers of and dealers in radio, television, electrical, electronic and telephone apparatus, sets and supplies of all kinds, etc. Directors: Lt.-Col. James Richens and K. M. Richens. Regd. office: 36, Blackfriars Street, Carlisle.

Reeslectrics, Ltd.—Registered 12th March. Capital £1,000. Manufacturers and repairers of, agents for and hirers and letters on hire of and dealers in electrical plant, machinery, fittings and accessories, refrigerators, washing machines, radio and television sets, etc. Directors: E. C. Rees and Mrs. Edwina E. Rees. Regd. office: 82, Western Street, Swansea.

Electrosystems, Ltd.—Registered 16th March. Capital £100. Manufacturers of and dealers in dynamos, motors, armatures, magnetos, etc. Directors: J. M. Dempsey and R. S. Glaister. Regd. office: 16, Shenley Road, Boreham Wood.

L. Hargreaves, Ltd.—Registered 17th March. Capital £2,000. Electrical engineers, etc. Directors: L. Hargreaves, Mrs. Marian Hargreaves and L. Beaumont. Regd. office: 11, All Saints Road, Bradford.

Scott Wilson (Electrics), Ltd.—Registered 13th March. Capital £5,000. Manufacturers of and dealers in electrical goods of all kinds, etc. Secretary: M. J. Bato. Regd. office: 11/13, Baker Street, W.1.

North Vision (Bristol), Ltd.—Registered 9th March. Capital £1,000. Electrical engineers and contractors, manufacturers, importers and exporters of and dealers in all kinds of electrical instruments, relays, control equipment, radio and television apparatus, etc. Directors: F. E. Stockham, G. S. Press, F. A. Hawkins, A. Mathers and Margaret Mitchell. Regd. office: 304, Gloucester Road, Bristol.

L. P. Tibbitts, Ltd.—Registered 19th March. Capital £1,000. Radio and television engineers, electrical engineers, etc. Directors: L. P. Tibbitts and Mrs. Helen P. Tibbitts. Regd. office: The Auction Rooms, Victoria Grove, Folkestone, Kent.

Simmons Electrical Services (Sutton), Ltd.—Registered 17th March. Capital £1,500. Designers, manufacturers, distributors of and dealers in electrical switches, switchgear and control devices, etc. Directors: C. E. Simmons and Lois M. Simmons. Regd. office: 269, Gander Green Lane, Cheam, Surrey.

Bankruptcies

J. E. Bowman, 21, Leazes Park Road, Newcastle-upon-Tyne, trading as Bowman Bros., electrical engineer and contractor.—Receiving order made 23rd March on debtor's own petition. Public examination 12th May at the Court House, 56, Westgate Road, Newcastle-upon-Tyne.

G. Dickinson and **K. G. Dickinson,** trading as G. & K. G. Dickinson at 134, Clipsley Lane and 321, Church Road, Haydock, Lancs., electricians.—Last day for receiving proofs for dividend 15th April. Trustee, Mr. S. O. Henry, 5, Rumford Place, Liverpool, 3.

AUSTRIA'S ELECTRICAL TRADE

DURING 1957 Austria's imports of electrical goods rose by 30 per cent to £16·8 million and her exports rose by 18 per cent to £11·1 million. As in previous years West Germany was the principal supplier, and imports from this source amounted to 62 per cent of the total in 1957. Other large suppliers were the Netherlands, Switzerland and the United States. Imports from the United Kingdom remained static at £460,000. The sources of imports and the main destinations of exports are shown in Tables 1 and 2.

Though Austria exports small amounts of electrical goods to most countries her main market is Europe, particularly West Germany, the Netherlands and Poland. Tables 3 and 4 indicate the importance of rotating machinery in Austria's electrical trade.

The further extension of Austria's ambitious power programme and TV network should provide opportunities for British manufacturers of nuclear equipment, domestic appliances, and such radio and TV components as are not manufactured locally or imported from the Netherlands or West Germany.

Table 1.—Sources of Austria's Electrical Imports in 1957

Country	Value (£000)
United Kingdom	460
West Germany	10,421
Italy	660
Belgium/Luxembourg	63
Denmark	90
France	275
Holland	1,654
Sweden	256
Switzerland	1,611
Czechoslovakia	79
Hungary	42
Canada	33
United States	1,135
Australia	22

Table 2.—Principal Destinations of Austria's Electrical Exports

Country	Value (£000)
United Kingdom	127
West Germany	1,119
East Germany	238
Italy	430
Belgium/Luxembourg	202
Bulgaria	394
France	322
Greece	194
Yugoslavia	641
Holland	1,273
Poland	1,282
Sweden	328
Switzerland	511
Czechoslovakia	235
Turkey	226
Russia	434
India	228

Table 2 (continued)

Country	Value (£000)
Pakistan	201
Egypt	229
South Africa	132
United States	511
Argentina	148
Australia	193

Table 3.—Austria's Electrical Imports in 1957

Product	Value (£000)
Motors, generators and parts	1,348
United Kingdom	29
West Germany	853
Italy	154
Holland	101
Sweden	21
Switzerland	82
United States	77
Generating sets, complete	188
West Germany	54
Switzerland	133
Portable electrical appliances, inc. domestic	4,501
United Kingdom	87
West Germany	3,372
Italy	68
Belgium/Luxembourg	45
Holland	235
Sweden	168
Switzerland	405
United States	41
Convertors, rotary	380
West Germany	83
Italy	53
Greece	47

Table 3 (continued)

Product	Value (£000)
Transformers	1,252
United Kingdom	23
West Germany	71
France	98
Yugoslavia	26
Poland	56
Sweden	88
Czechoslovakia	29
Turkey	76
Egypt	23
South Africa	27
United States	333
Australia	178
Telegraph and telephone apparatus	345
Radio components	733
United Kingdom	24
West Germany	274
Holland	395
Electro-acoustical equipment	1,345
United Kingdom	21
West Germany	407
Holland	110
United States	707
X-ray apparatus and electro-medical appliances, incl. X-ray tubes	343
Measuring, indicating and recording instruments	315
West Germany	239
Filament lamps	315
Fluorescent lamps	36
Electronic tubes	391
Heating appliances	1,044
United Kingdom	15
West Germany	700
Italy	215
Switzerland	78
United States	17
Cables, lead covered	19
Cables and wires, others	148
United Kingdom	2
West Germany	81
Holland	21
Switzerland	29
Electric locomotives	98
Steam engines and turbines	285
Water turbines and parts	961
West Germany	805
Italy	119

Table 4.—Austria's Electrical Exports in 1957

Product	Value (£000)
Motors, generators and parts	1,523
United Kingdom	1
West Germany	83
Italy	81
Bulgaria	225
France	39
Holland	75
Poland	93
Sweden	46
Switzerland	79
Russia	272
India	131

Table 4 (continued)

Product	Value (£000)
Pakistan	57
United States	58
Australia	48
Generating sets, complete	173
Argentina	73
Portable electrical appliances, incl. domestic	275
United Kingdom	11
West Germany	32
Italy	28
Yugoslavia	43
Holland	28
Switzerland	54
United States	11
Convertors, rotary	45
West Germany	31
Transformers	683
United Kingdom	14
West Germany	406
Italy	41
France	31
Switzerland	103
United States	33
Telegraph and telephone apparatus	565
Radio apparatus	273
Radio components	172
West Germany	18
Yugoslavia	19
Holland	20
Poland	44
Electro-acoustical equipment	1,174
United Kingdom	33
West Germany	24
Holland	585
Switzerland	28
Russia	44
X-ray and electro-medical appliances, incl. X-ray tubes	272
Measuring, indicating and recording instruments	501
West Germany	41
Yugoslavia	60
Poland	134
Sweden	37
India	31
Filament lamps	242
Fluorescent lamps	8
Electronic tubes	325
Heating appliances	565
West Germany	82
Yugoslavia	153
Poland	25
Switzerland	36
Czechoslovakia	108
Cables, lead covered	620
Bulgaria	51
Poland	279
Russia	80
Egypt	84
Cables and wires, others	428
West Germany	49
Bulgaria	55
Yugoslavia	34
Poland	180
Accumulators	102
Electric locomotives	59
Steam engines and turbines	86
Water turbines and parts	575
West Germany	265
Italy	128
Russia	182

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1954

7251/2. Lancashire Dynamo Electronic Products, Ltd., and Whitlock, R. H.—Remote indicating and recording systems. 13th June, 1955. (811421/2.)

19335. General Electric Co., Ltd.—Frequency compensating arrangements. 1st July, 1955. (811491.)

20371. Shardlow Electric Wires, Ltd., and Hargreaves, F. G.—Electric cables and method of and means for manufacturing them. 12th July, 1955. (811703.)

25642. English Electric Co., Ltd.—Electric motor control systems. 2nd September, 1955. (811571.)

28935. Metropolitan-Vickers Electrical Co., Ltd.—Protection relay arrangements for polyphase motors. 7th October, 1955. (811705.)

35895. English Electric Co., Ltd.—Fluid control valve systems. 6th December, 1955. (811706.)

1955

4963. Levell, D. A.—Secondary radar systems. 13th February, 1956. (Cognate application 11957, 26th April, 1955.) (811496.)

6817. Metropolitan-Vickers Electrical Co., Ltd.—Vehicle parking meters. 6th March, 1956. (811497.)

17299. General Electric Co.—Semiconductor devices. 15th June, 1955. (811711.)

18836. General Electric Co.—Dual capacity refrigeration systems. 29th June, 1955. (811713.)

20704. Marconi's Wireless Telegraph Co., Ltd.—Subaqueous echo sounders. 12th June, 1956. (811440.)

22958. General Electric Co., Ltd.—Cathode-ray tubes. 31st July, 1956. (811724.)

26691. Westinghouse Electric International Co.—Electric heating apparatus. 19th September, 1955. (811445.)

27160. Collins Radio Co.—Signal-to-noise squelch control circuit. 23rd September, 1955. (811728.)

33237. International Business Machines Corporation.—Printed circuit connections. 21st November, 1955. (811509.)

36110. International Business Machines Corporation.—Electrical data storage device. 16th December, 1955. (811450.)

36971. General Electric Co., Ltd.—Television receivers. 11th December, 1956. (811451.)

37305. Bendix Aviation Corporation.—Magnetic electron multiplier circuits. 29th December, 1955. (811452.)

1956

2230. Siemens & Halske A.G.—Electromagnetic relays. 23rd January, 1956. (811512.)

6860. Rotork Engineering Co., Ltd.—Electric actuators for fluid-flow control valves. 1st February, 1957. (Addition to 774303.) (811640.)

14779. Math, F.—Electrical resistances and a method of manufacturing them. 11th May, 1956. (811652.)

15628. Sylvania Electric Products, Inc.—Mounting of deflection coils and focusing units on cathode-ray tubes. 18th May, 1956. (811736.)

16744. Kwan, S. M.—Electric torches. 29th May, 1957. (811583.)

17699. United Kingdom Atomic Energy Authority.—Methods and apparatus for converting small unidirectional e.m.f.'s into related alternating quantities. 30th May, 1957. (811657.)

19776. Pfenningsberg G.m.b.H., P.—Control of electrically driven washing machines. 26th June, 1956. (811661.)

19800. Multitone Electric Co., Ltd.—Transmitters for inductive signalling systems. 24th June, 1957. (811467.)

20086. Siemens & Halske A.G.—Electromagnetic waveguides. 28th June, 1956. (811738.)

20361. Marie, G. R. P.—Resonant directional waveguide coupler. 2nd July, 1956. (811662.)

20496. Decca Record Co., Ltd.—Pulse radar apparatus. 26th June, 1957. (811470.)

21911. Lopez, A. C.—Electric signal transmitter and receiver system for communication between vehicles. 16th July, 1956. (811471.)

23295. Philips Electrical Industries, Ltd.—Transistor circuits with varying input impedance. 27th July, 1956. (811671.)

24417. General Electric Co., Ltd.—Control apparatus for mine winders of the friction type. 9th August, 1957. (811587.)

24993. Illinois Tool Works.—Electrical terminal clips for mounting on panel members. 15th August, 1956. (811674.)

26030. Carr Fastener Co., Ltd.—Coaxial cable connectors. 2nd August, 1957. (811589.)

28104. Electric & Musical Industries, Ltd.—Signal amplifiers. 16th September, 1957. (811753.)

28772. General Electric Co., Ltd.—Thermo-electric devices. 20th September, 1957. (811755.)

29408. Montecatini Soc. Generale per l'Industria Mineraria e Chimica.—Thermionic valve holders. 26th September, 1956. (811593.)

30570. Draley, J. E., and Ruther, W. E.—Nuclear reactors and subassembly therefor. 8th October, 1956. (811528.)

31796. General Electric Co., Ltd.—Heat transfer arrangements. 18th October, 1957. (811597.)

32868. E.M.B. Co., Ltd.—Electrical resistances. 8th August, 1957. (811759.)

34331. British Thomson-Houston Co., Ltd.—Safety systems for nuclear reactors. 30th October, 1957. (811600.)

34846. South African Council for Scientific and Industrial Research.—Devices for determining position by means of the transit time of radiated waves. 14th November, 1956. (811762.)

36717. General Electric Co., Ltd.—Audio frequency amplifiers. 2nd December, 1957. (811766.)

1957

2302. Collins Radio Co.—Sideband selecting system. 22nd January, 1957. (811540.)

2459/60. Siemens-Reiniger-Werke A.G.—High tension barrier layer rectification units. 23rd January, 1957. (811479/80.)

10415. Naimer, H.—Cam controlled actuating mechanism for electrical switches. 29th March, 1957. (811607.)

10598. Hubbell, Inc., H.—Top wired electrical plug or socket connector. 1st April, 1957. (811690.)

11245. Sylvania Electric Products, Inc.—Thermally operated electric switching system. 5th April, 1957. (811483.)

15227. Allezard, R. A.—Circularly polarised microwave antenna having an axial radiation. 14th May, 1957. (811611.)

18789. Belling & Lee, Ltd.—Electrical cut-out devices. 14th June, 1957. (811429.) 18790. Electrical bimetallic cut-out devices. 14th June, 1957. (811430.) 18791. Electrical cut-out devices. 14th June, 1957. (811431.)

21383. Standard Telephones & Cables, Ltd. (Fabbrica Apparecchiature per Comunicazioni Elettriche Standard, Soc. p.a.).—Electromagnetically operated switch. 5th July, 1957. (811553.)

22937. Philips Electrical Industries, Ltd.—Switching circuit arrangements incorporating electric discharge tubes. 19th July, 1957. (811554.)

34888. Standard Telephones & Cables, Ltd.—Methods of manufacturing a colour T.V. receiver tube. 8th November, 1957. (811625.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 25th April:—

No. B720,458 (design). Class 9. Electrical switchgear for industrial installations and machines; electrical apparatus for use in operating machines, engines and motors by current control; fitted electric switchboards, distribution boards, armatures, temperature regulators, fuses and resistances; and parts.—Klöckner-Moeller Elektrizitäts G.m.b.H., Bonn a. Rhein, Germany. Address for service, c/o A. M. & Wm. Clark, 5, Stone Buildings, Lincoln's Inn, London, W.C.2.

Stereostatic. No. 780,767. Class 9. Loudspeakers incorporating moving electric coils, and parts.—Goodmans Industries, Ltd., Axiom Works, Lancelot Road, Wembley, Middx.

Knightrider. No. 781,968. Class 9. Electrical apparatus and instruments; sound reproducing and television apparatus and instruments; and parts.—H. E. Kettle, Ltd., The Priory, Knightrider Street, Maidstone, Kent.

Colormat. No. 783,239. Class 9. Photoelectric colorimeters.—Baldwin Instrument Co., Ltd., Brooklands Works, Lowfield Street, Dartford, Kent.

Aquacel. No. 783,873. Class 9. Electric batteries.—McMurdo Instrument Co., Ltd., Victoria Works, Ashtead, Surrey.

Durathene. No. 783,983. Class 9. Insulated electric wire and insulated electric cables.—Duratube & Wire, Ltd., 39, Dover Street, London, W.1.

Pottagator. No. 783,267. Class 11. Electrically heated horticultural and agricultural apparatus and installations, all for use in propagating and growing seeds, seedlings and plants.—Peter Potter, Ltd., 1, Drapers' Gardens, Throgmorton Avenue, London, E.C.2.

CATALOGUES AND LISTS

BUSBARS.—Illustrated catalogue dealing with "Noral" rectangular aluminium busbars. —**Northern Aluminium Co., Ltd.,** Banbury, Oxon.

CLEANING EQUIPMENT. — Pamphlet (5014) dealing with a new industrial type vacuum cleaner.—**Sturtevant Engineering Co., Ltd.,** Southern House, Cannon Street, London, E.C.4.

FANS.—12-page catalogue (L.P.591) covering the range of "Breeza" propeller fans.—**London Fan & Motor Co., Ltd.,** 27, Brecknock Road, London, N.7.

GEARS. — 48-page catalogue describing gears and gear units produced by the company. —**Turbine Gears, Ltd.,** Cheadle Heath, Stockport, Cheshire.

INSTRUMENTS.—Nine loose-leaf catalogue pages dealing with instruments produced by the company.—**Bailey Meters & Controls, Ltd.,** Purley Way, Croydon.

LIGHTING FITTINGS.—Folder giving particulars, prices and illustrations of fluorescent control gear and accessories.—**Ekco-Ensign Electric, Ltd.,** 45, Essex Street, London, W.C.2.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

MONDAY, 13th APRIL

Cheltenham.—St. Mary's College, 6 p.m. I.E.E. Western Centre. "Transistors in Communication and Control Equipment—A General Survey," by E. Wolfendale.

London.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "The Function and Content of an Electric Theory Course," opened by F. E. Rogers.

White Hall Hotel, Bloomsbury Square, W.C.1, 7.15 p.m. A.S.E.E. Central London Branch. "Modern Lifts," by A. Little.

Newcastle-on-Tyne.—Royal Station Hotel, 6.15 p.m. I.E.E. North Eastern Centre. Annual general meeting and conversazione.

Sheffield.—Grand Hotel, 6.30 p.m. I.E.S. Sheffield Centre. Annual general meeting, followed by technical films.

Wembley Park.—Century Hotel, Forty Avenue, 8.15 p.m. A.S.E.E. North West London Branch. "Engineering Photoelectrics," by Dr. L. E. C. Hughes.

York.—Georgian House, Blossom Street, 7.30 p.m. A.S.E.E. York Branch. Films.

MONDAY, 13th APRIL to FRIDAY, 17th APRIL

Cardiff.—I.E.S. Cardiff Centre. Visits to Independent Television studios.

TUESDAY, 14th APRIL

Belfast.—Queen's University, Stranmillis Road, 6.30 p.m. I.E.E. Northern Ireland Centre. "The Use of Analogue Computing Elements in the Design of Automatic Control Systems," by Professor J. C. West and Dr. J. L. Douce.

Cambridge.—Cavendish Laboratory, Free School Lane, 7 p.m. I.E.E. Cambridge Radio and Telecommunication Group. Six short papers on "Application of Electronics."

Glasgow.—Royal College of Science and Technology, George Street, 7 p.m. I.E.E. South West Scotland Sub-Centre. "The Application of Transistors to Line Communication Equipment," by H. T. Prior, D. J. R. Chapman and A. A. M. Whitehead, and "The Application of Junction Transistors to Audio Frequency Telephone Line Amplifiers," by H. G. Bassett, D. Thomson and P. E. Greenaway.

Huddersfield.—The Training College, 6.30 p.m. I.E.E. North Midland Education Discussion Circle. Discussion on "Teaching Technique in Early Years of Craft Courses."

London.—Institution of Civil Engineers, Great George Street, S.W.1, 6.30 p.m. I.E.E. London Graduate and Student Section and Institutions of Civil and Mechanical Engineers, Graduate and Student Sections. "Finance and the Engineer," by Lord Chandos.

Connaught Rooms, W.C.2, 11.45 a.m. Electrical Industries Club. Annual general meeting, followed at 12.30 for 1 p.m. by luncheon. Speaker, Sir Dermot Boyle.

76, Mark Lane, E.C.3, 5.30 p.m. Institute of Marine Engineers. "Boiler Refractories: Operating Temperatures and Recent Developments in Construction," by W. McClimont, H. M. Richardson and B. Taylor.

Manchester.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North Western Supply Group. "Development of High-Voltage Air-Break Circuit-Breakers with Insulated Steel Plate Arc Chutes," by F. S. Fay, J. A. Thomas, D. Legg and J. S. Morton.

Central Library, St. Peter's Square, 6.30 p.m. Society of Instrument Technology. "Weighing," by T. A. Delve.

Newcastle-upon-Tyne. — County Hotel. Institution of Heating and Ventilating Engineers, North East Coast Branch. Annual general meeting.

Portsmouth.—At the Ministry of Labour and National Service, Lake Road, 7.30 p.m. A.S.E.E. Portsmouth and District Branch. "Electricity in Aircraft," by R. N. Lake.

WEDNESDAY, 15th APRIL

Barrow-in-Furness.—North Western Electricity Board, Duke Street, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. "Electrical Installation at Calder Hall Nuclear Power Station," by N. J. Mackay and E. Hardwick.

Birmingham.—College of Technology, Gosta Green, 6.30 p.m. Institution of Chemical Engineers. Joint meeting of the Midlands Branch with the Midlands Centre and Graduate and Student Section, and with the Chemical Engineering Group of the Society of Chemical Industry. "Electrical Engineering in the Chemical Industry," by D. Birch.

London.—I.E.E. London Graduate and Student Section, 2.30 p.m. Visit to Whitbread & Co., Ltd., Brewery, Chiswell Street, E.C.1.

Luton.—Chamber of Commerce, George Street West, 8 p.m. A.S.E.E. Luton Branch. "Lift Maintenance."

Middlesbrough.—Cleveland Scientific and Technical Institute, Corporation Road, 7.30 p.m. Society of Instrument Technology, Tees-Side Section. "Instrumentation of Open-Hearth Furnaces," by C. Holden.

Newcastle-on-Tyne.—Royal Station Hotel. Combustion Engineering Association, Northern Region. 10.30 a.m. "Furnaces as a Source of Fuel Economy," by A. L. Hancox. 2.30 p.m. "The Economics of Thermal Insulation," by J. C. Stainton.

King's College, Stephenson Buildings, 7 p.m. Society of Instrument Technology, Newcastle Section. "Radiation Pyrometers," by R. Barber.

Sheffield.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. "Subscriber Trunk Dialling," by D. A. Barron.

Wolverhampton.—A.S.E.E. Wolverhampton and District Branch, 7.30 p.m. Visit to W. Butler & Co., Ltd.

THURSDAY, 16th APRIL

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Utilisation Section. "An Electromagnetic, Variable-Ratio, Torque Convertor," by Dr. D. O. Bishop and Dr. G. S. Brosan.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Diesel Engineers' and Users' Association. Annual luncheon.

John Adam Street, Adelphi, W.C.2, 5.15 p.m. Royal Society of Arts, Commonwealth Section. "Britain and the Technical Development of Eastern Commonwealth Countries under the Colombo Plan," by Dr. W. Railston.

Manson House, Portland Place, W.1, 6 p.m. Society of Instrument Technology, Control Section. Annual general meeting followed by "Self-Optimising Control System for a Certain Class of Randomly Varying Inputs," by A. P. Roberts.

Loughborough. — College of Further Education, Greenclose Lane, 7 p.m. Society of Instrument Technology, East Midland Section. Annual general meeting, followed by an address by the president.

Manchester. — Engineers' Club, Albert Square, 7 p.m. I.E.E. North Western Graduate and Student Section. "The Radio-Telescope," by D. F. Mathewson.

Plymouth.—S.W.E.B., New George Street, 3 p.m. I.E.E. South Western Sub-Centre. "Earthing of Low- and Medium-Voltage Distribution Systems and Equipment," by F. Mather. (Joint meeting with Western Supply Group.)

Stone.—Duncan Hall, 7 p.m. I.E.E. North Staffordshire Sub-Centre and Institution of Post Office Electrical Engineers. "Subscriber Trunk Dialling," by D. A. Barron.

THURSDAY, 16th APRIL to THURSDAY, 30th APRIL

London.—Olympia. Engineering, Marine, Welding and Nuclear Energy Exhibition.

FRIDAY, 17th APRIL

Birmingham.—College of Technology, Gosta Green, 6.15 p.m. I.E.E. South Midland Education Discussion Circle. Discussion on "The Mathematical Content of Advanced Electrical Engineering Courses," opened by Dr. N. Mullineux.

Crewe.—Royal Hotel, 7.30 p.m. A.S.E.E. Stoke and Crewe Branch. Films night.

Edinburgh.—The University, Drummond Street, 6.30 p.m. British Institution of Radio Engineers. Annual general meeting followed by "Stereophonic Sound and the Electrostatic Loudspeakers," by D. T. N. Williamson.

Liverpool.—College of Building, Clarence Street, 6.30 p.m. Institution of Heating and Ventilating Engineers, Liverpool and District Branch. Annual general meeting.

London.—Grosvenor House, Park Lane, W.1, 6 for 6.30 p.m. Association of Supervising Electrical Engineers. Annual dinner and reunion.

Palmerston Restaurant, Bishopsgate, E.C., 6 for 6.45 p.m. E.P.E.A. Meter Engineers' Technical Group. Annual dinner.

Dorchester Hotel, Park Lane, W., 7 for 7.45 p.m. Television Society. Annual dinner and dance.

Portsmouth.—College of Technology, 7 p.m. Institution of Electronics, Southern Division. "Modern Developments in Stereophonic Sound," by A. C. Bowyer-Lowe.

Sheffield.—Royal Victoria Hotel, 7.30 p.m. I.E.E. Sheffield Sub-Centre. Annual dinner-dance.

SATURDAY, 18th APRIL

Grantham.—St. Wulfram's C.E. Secondary Modern School, Harrowby Lane. Electrical Association for Women. One-day conference on "The Teaching of Electrical Housecraft."

Holme-on-Spalding-Moor.—A.S.E.E. York Branch, 10.30 a.m. Visit to the Northern Dairies.

Oxford.—St. John's Hall, Marston Street, 7 p.m. A.S.E.E. Oxford and District Branch. "Refrigeration."

Hoover Competitions

Hoover, Ltd., is to hold a sales contest for authorised dealers from 31st March to 16th May, and a competition for the public from 7th April to 16th May. The dealer contests will have £10,000 in prizes, made up of "Hoovermatics," "Spinarinses" and steam-or-dry irons, plus an opportunity for twenty people to come to London as the guests of the company for three days, and to attend the Derby. The prizes will be based on the success of dealers in stimulating sales of the "Hoovermatic."

In the public contest 100 "Hoovermatics" will be awarded to the successful competitors who, in the opinion of a panel of judges, list its advantages in the order most likely to appeal to the housewife and, in addition, supply the best 20-word phrase as to why they would like to own a "Hoovermatic." The judges will be Miss Ruth Drew, Miss Mary Gilbert (women's press liaison officer, British Electrical Development Association) and the sales manager of Hoover, Ltd.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—State Electricity Commission of Queensland, Brisbane. 10th June. Two 33,330 kVA 3-phase generator transformers. (E.S.B. 7258/59. Ten/38166.)*

Postmaster General's Department, Melbourne. 30th April. No-break a.c. supply plant. (E.S.B. 7331/59. Ten/38237.)* 5th May. Switch-hooks. (E.S.B. 7835/59. Ten/38214.)*

Southern Electricity Authority of Queensland, Brisbane. 12th May. 33 kV/11 kV outdoor type transformer. (E.S.B. 8039/59. Ten/38254.)*

Bournemouth.—Corporation. 30th April. Street lighting equipment. (See this issue.)

Bridlington.—Corporation. 21st April. Cable. (See this issue.)

Burma.—Burma Purchase Board, Rangoon. 16th April. Electric soldering irons and solder guns. (E.S.B. 8159/59. Ten/38287.)*

Ceylon.—Department of Government Electrical Undertakings, Colombo. 15th April. Fifty electrically driven water pumping sets. (E.S.B. 7751/59. Ten/38203.)*

Colombia.—Empresa Colombiana de Aerodromos. 15th April. Escalators and plate lifts. (E.S.B. 8113/59. Ten/38284.)*

Down.—County Education Committee. 23rd April. Electrical installation in Newtownards (new) Technical School. McAusland & Abbott, consulting engineers, 16, Bedford Street, Belfast.

Dumfries.—County Council. 4th May. Trunk road lighting equipment. (See this issue.)

Edinburgh.—North of Scotland Hydro-Electric Board. Electrical installation at Cashlie power station and Giorra Dam. (See this issue.)

Hastings.—Corporation. 27th April. Electrical installation in the new Moreton Home for Aged Persons, Boscobel Road. Borough engineer, 37, Wellington Square.

Huddersfield.—Corporation. 21st April. Electrical installation at Rawthorpe County Junior School. Borough architect, High Street Buildings.

India.—India Supply Mission. Water-tube boiler, power circuit-breakers, centrifugals, and control panels. (See this issue.)

Iran.—Purchasing Department, P.T.T. Ministry, Teheran. 19th April. Cable, iron wire and cable boxes. (E.S.B. 7372/59. Ten/38205.)* Connection and line protection boxes, and waterproof boxes. (E.S.B. 7379/59. Ten/38216.)* 6th May. Telephone equipment. (E.S.B. 7945/59. Ten/38266.)*

Plan Organisation, Teheran. 6th May. Electrical system for six towns. (E.S.B. 7376/59. Ten/38182.)* 22nd June. Electric motors, switches and starters for Sugar Factories Co. (E.S.B. 7309/59. Ten/38161.)*

Iran Sugar Refinery Corporation, Teheran. 10th May. Cable. (E.S.B. 7374/59. Ten/38204.)*

Korea.—Government Office of Supply, Seoul. 30th April. Electrical apparatus, including watthour meters, capacitors, transformers, automatic oil circuit reclosers, step-voltage regulators, insulation testers, etc. (E.S.B. 7623/59/I.C.A. Ten/38222.)*

Manchester.—Corporation. 4th May. Electrical installation at Moston College for Further Education. (See this issue.)

Midlothian.—County Council. 30th April. Trunk road lighting equipment. (See this issue.)

Peacehaven.—Parish Council. 25th May. Street lighting equipment. (See this issue.)

Portuguese East Africa.—Government Purchasing Commission, Lourenço Marques. 5th May. Switchboards for the Civil Aeronautical Department, Beira. (E.S.B. 7213/59. Ten/38207.)*

Randalstown (Co. Antrim).—30th April. Electrical installation in voluntary primary school. Varming & Mulcahy, consulting engineers, 37, Malone Road, Belfast.

South Africa.—Union Tender Board, Pretoria. 22nd April. Radar equipment. (E.S.B. 7961/59. Ten/38247.)*

Johannesburg City Council. 20th April. Two electrically operated passenger lifts. (E.S.B. 8117/59. Ten/38265.)*

Pretoria City Council. 14th April. 11,500 V ring main switchgear units with metering equipment. (E.S.B. 8393/59. Ten/38321.)*

Wiltshire.—County Council. Electrical installation in additional classrooms at Trowbridge Boys' High School. (See this issue.)

ORDERS PLACED

Barnsley.—Corporation. Electrical services for phases 3 and 4 of extensions to the College of Technology (£16,638).—Pinching & Walton.

Harpenden.—U.D.C. Steel street lighting columns in High Street and Luton Road (£3,411).—Engineering & Lighting Equipment Co.

Hartlepool.—Corporation. Electrical installation in houses (£3,853).—Williams Brothers (Electrical).

London.—Bermondsey General Purposes Committee. Recommended. Improvement of street lighting in various main roads (£26,926).—Erecon.

Metropolitan Water Board. 500 kVA transformer for the Shortlands pumping station (£1,292).—Bonar Long & Co. Electric cables, conduit, switchgear, lighting fittings, etc., at Bexley pumping station (£9,243).—Rashleigh Phipps & Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Acton.—Sixteen-storey block of flats, Osborne Road; S. Sleight, borough engineer, Town Hall, W.3.

Factory, Colville Road; Henderson Engineering, Ltd., 15, Enfield Road.

Alcester.—New offices and Council chamber; C. B. Machin, surveyor, Council Offices, Kinwarton Road, Alcester, Warwicks.

Ascot. — Additional accommodation at Heatherwood Hospital (£122,518); regional architect to Hospital Board, 40, Eastbourne Terrace, London, W.2.

Aylesbury.—Municipal block to house all Council departments; borough surveyor, Friarscroft, 3, Oxford Road.

Birkenhead.—Office block, Cleveland Street and Argyle Street; Wm. Thornton & Sons, Ltd., 38, Wellington Road, Liverpool.

Birmingham.—Office block; Henry M. Hale & Partners, consulting engineers, 125, Edmund Street.

Blaydon-on-Tyne.—R.C. church and hall at Winlaton; R. Burke, architect, 10, Lambton Road, Newcastle-on-Tyne.

Bristol.—Seven-storey shop and office block, Baldwin Street; Site Improvements, Ltd., 1, Queen Anne's Gate, London, S.W.1.

Chester.—Houses (151), Plas Newton; city surveyor, 43, Northgate Street.

Cleator.—Extensions for Cumberland Paper Co., Ltd.; John Laing & Son, Ltd., Dalston Road, Carlisle.

Coventry.—Office block, Corporation Street; Higgs & Hill, Ltd., Swan Lane.

Croydon.—Dwellings (172), Castle Hill estate; borough engineer.

Doncaster.—Egg packing station; Yorkshire Egg Producers, Ltd., 295, City Road, Sheffield, 2.

Enfield.—Civic offices, Baker Street; Allen Fairhead & Sons, Ltd., builders, Sydney Road.

Essex.—Fire station at Canvey Island (£26,000); H. Conolly, county architect, County Hall, Chelmsford.

Gateshead.—Sixteen-storey flats and four-storey blocks of maisonnettes, Chandless redevelopment area; G. F. Winters, borough engineer.

Hastings.—Shops, showrooms and stores, Castle Street; Shop Development Group of Companies, 12, St. George Street, London, W.1.

Haverhill.—Factory, industrial estate; J. C. Myers, architect, 23, High Street, Haverhill, Suffolk.

Hounslow.—Works, Green Lane, for Perrett Controls, Ltd.; E. H. Burgess, Ltd., builders, Great West Road, Brentford.

Long Sutton.—Court house and offices for Holland County Council; county architect, Boston, Lincs.

Southampton.—Swimming baths, Western Esplanade; borough architect, Civic Centre.

South Ruislip.—Factory, Stonefield Way; Commercial Ignition, Ltd., Great West Road, Brentford.

Staffordshire.—Infants' school, Wheel Lane, Lichfield (£42,350) and combined fire and ambulance station at Biddulph; A. C. H. Stillman, county architect, County Buildings, Martin Street, Stafford.

Staines.—Houses (45), Town Lane, Stanwell; F. Entwistle, clerk, 73, High Street.

Sutton and Cheam.—Civic centre; A. Marshall & Partners, consulting engineers, 73, High Holborn, London, W.C.

Taunton.—Crematorium, Taunton Deane Cemetery (£104,250); borough architect, Flook House, Station Road.

Thetford.—Secondary modern school; Tooley & Youngs, Ltd., builders, Stalham, Norwich.

Tynemouth.—Houses (92) and bungalows (20), Tudor estate; J. H. Rogers, builder, Regent Terrace, North Shields.

Health centre, Spring Gardens, North Shields (£63,000); F. P. Dodsworth, contractor, Hill Heads Road, Whitley Bay.

Whitehaven.—Factory additions for Smith Brothers (Whitehaven), Ltd.; Ward & Partners, architects, 29, Chesham Place, London, S.W.1.

Wokingham.—Maternity unit at Wokingham Hospital (£92,000); regional architect to Hospital Board, 40, Eastbourne Terrace, London, W.2.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).